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ABSTRACT

This paper describes a research and development center's project to design procedures for helping students both to develop and to apply effective behaviors for understanding text. The project's developmental efforts are summarized and promising directions for future work are examined. Specifically, the paper (1) clarifies the goals of the project, (2) describes an instructional technique that is being developed to pursue the overall goal, (3) presents the results and implications of two pilot studies, (4) examines selected literature for additional direction, and (5) discusses possible next steps for refining the technique that is being developed. (Author/FL)

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TEXT COMPREHENSION RESEARCH TO CLASSROOM APPLICATION: A PROGRESS REPORT

by

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Report from the Project on
Improving Student's Understanding
of Content-Area Texts

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- conducting and synthesizing research to clarify the processes of school-age children's learning and development
- conducting and synthesizing research to clarify effective approaches to teaching students basic skills and concepts
- developing and demonstrating improved instructional strategies, processes, and materials for students, teachers, and school administrators
- providing assistance to educators which helps transfer the outcomes of research and development to improved practice in local schools and teacher education institutions

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Abstract

The goal of the Wisconsin R & D Center's project on Improving Student's Understanding of Content Area Texts is to design procedures for helping students both to develop and to apply effective behaviors for understanding expository text. The projects' early efforts were focused on helping students develop and apply specific comprehension skills, and more recently the scope of focus has been broadened to include the development of more general teacher-directed and student-directed strategies for understanding content-area materials. In this paper the projects' developmental efforts to date are summarized and promising directions for future work are examined. Specifically, the paper is intended to (a) clarify the goals of the project, (b) describe an instructional technique that is being developed to pursue the overall goal, (c) present the results and implications of two pilot studies, (d) examine selected literature for additional direction, and (e) discuss possible next steps for refining the technique that is being developed.

Based on our observations in elementary school classrooms and interviews with school personnel (Kamm & White, 1979) we have found that teachers who have appropriate materials and procedures do in fact teach--and their students do in fact learn--comprehension skills. But we also observed that these same teachers seldom offer their students explicit instruction or directed practice on how to apply the skills in reading tasks outside of formal instruction. Teachers express their concern for the problem in at least three ways. First, they wonder whether the skills students learn either in skill-centered instructional groups or in their basal reader groups are ever applied in real-life reading. Second, they are worried because their students have difficulty understanding content-area texts. And finally, but optimistically, they ask for specific suggestions on how they can help their students make the transition from learning skills to applying them when they read content-area materials.

In this paper we describe our efforts to design procedures for helping students both to develop and to apply effective behaviors for understanding text. To the present time we have paid particular attention to the development and application of the specific comprehension skills we identified for our work in developing a skill-centered approach to teaching reading (Otto & Kamm, 1977).

In our most recent work we have, however, broadened our focus to include not only specific skills but also student-directed and teacher-directed strategies designed to enhance students' understanding of text. We are using the generic term gloss to refer to the activities, techniques, and procedures we are developing. (Since medieval times the term has been applied to marginal or interlinear words, notes of explanation.) In this paper we (a) clarify our goals, (b) describe gloss as we have developed it, (c) present the results and implications of two pilot studies with glossed materials, (d) examine selected literature for additional direction, and (e) discuss possible next steps for refining gloss and techniques for glossing.

WHY GLOSS?

Our goal is to develop procedures for helping students to apply as well as to acquire reading comprehension skills and strategies. We became interested because we are troubled by a HUMPTY DUMPTY PHENOMENON. That is, we see specific skills identified for instructional purpose, we see them taught in isolation, and we find that all the kings' horses and all the kings' men can't put them back together again! So there is some bad news as well as some good news.

The good news is: Specific comprehension skills can be taught. We identified specific comprehension skills as we developed the comprehension element of the Wisconsin Design for Reading Skill Development. And we know that after a period of skill-centered instruction students can pass criterion-referenced tests as a demonstration of their "mastery" of a specific skill. The bad news is that such a demonstration of mastery carries no assurance that the specific skills can or will be applied in real-life reading, particularly in reading the type of expository materials typically found in content-area texts.

The problem, as we see it, is not that "teaching skills in isolation" automatically precludes any sensible application, as some critics of skill-centered teaching suggest. To the contrary, the very practice of identifying specific skills and focusing instruction on those skills is what makes it possible to "teach" reading comprehension, as contrasted to providing ancillary aides like questions or advance organizers, which really amount to nothing more than temporary crutches. The problem is that very few teachers give their students any help in applying the skills once they have been developed, and very few students apply them spontaneously in content-area reading. The solution, then, is not to abandon skill-centered teaching, but to provide the help students need in order to make effective use of the skills they acquire through skill-centered teaching. To borrow a term from LaBerge and Samuels (1974), teachers need to help their students attain automaticity in applying comprehension skills as well as word attack skills.

These are some of the fantasies that occurred to us as we began to think about the problems related to skill-application.

- Perhaps if we taught skills in context, students--and teachers--would be less inclined to view them or to let them remain in isolation. That is, if we didn't encourage the isolation of skills in the first place, then there might not be so much of a problem in getting them applied.

- If we could get students to think about--to be aware of--the skills they have while they read, then, would they be more inclined to develop basic, transferable, useable skills? Then, wouldn't they be more inclined to develop those skills to a point of automaticity?

And wouldn't they be better off with such personal skills than with the crutches--questions, advance organizers, etc.--that are often provided but never internalized?

- If we could show students how to use skills while they read, then, wouldn't they be better able to use them on their own, and mightn't they score better on both general and specific tests of comprehension?

In other words, we wondered if by doing a better job of actively involving students in their own reading performance we could help them to become more independent and effective readers in all curriculum areas.

Fortunately, there is an extensive body of research that appears to be relevant to our attempts to transform fantasies into realities. Investigators have devised and examined many different ways to help students learn from reading--prequestions, postquestions, interspersed-questions, advance organizers, cognitive maps, marginal notes, objectives. Other investigators have begun to examine the text and the reader's knowledge and concepts in order to better understand the interactions between readers and texts--and they have come up with text analysis routines, schemes for assessing and enhancing readers' knowledge structures, and procedures for examining readers' understanding of their own reading-related behaviors.

And so, taking all these things--our observations in the field, our fantasies, and the related research--into consideration, the idea of gloss began to take shape. Why not use notations in the margins to direct readers' attention while they read? That is, rather than rely on questions or advance organizers, actively direct readers' attention to passages where skills can be applied, to examples of specific skill-related tasks, and to key words and ideas. In other words, attempt to give a developing reader a mature reader's insights into the reading process.

Up to the present time, we have prepared and tried out some glossed materials. The materials and pilot tryouts of those materials are described in the pages that follow. We have learned enough to have some confidence in the potential of the gloss technique and also to begin to see some directions for its refinement and further development. And we have much more confidence in our goal: To help students develop and apply specific comprehension skills as they read content material.

We expect to make full use of any of the existing techniques for helping students learn from reading that promise and prove to be useful. At the same time we hope to discover ways to help students not only develop but also internalize and apply the skills, strategies, and structures that make for effective reading performance. Our quest continues to be guided by our experience with skill-centered teaching and the results of our pilot studies. In addition we are seeking implications from several promising lines of research related to reading comprehension. Our approach to the related research is described in detail in the final sections of this paper.

PROTOTYPE GLOSSED MATERIALS

One of our earliest concerns was whether teachers and students would respond positively to glossed materials. That is, would they find the gloss materials and activities sufficiently palatable to sustain interest and productivity? To get at least a tentative answer to this question we developed and tried out some prototype materials which include (a) a text based on an environmental theme, (b) activity sheets to accompany the text, (c) a multiple-choice content test, and (d) a skills-application test. In this section, we describe the materials.

The Text

Life in Ecosystems, which is based on information gathered for a Center environmental education project, was written expressly for the purpose of investigating gloss. The text is written in a style similar to social studies texts and it is divided into four units. According to the Fry Formula (1968) readability ranges between grade levels 5.6 and 7.7 for the four units. The first unit, "Ecosystems," defines environmental terms, describes a pond ecosystem, and discusses the role of people in ecosystems as an introduction to the other units. The second unit, "The Kalahari Desert," describes the life of people who live as hunters and gatherers and how they adapt to the desert ecosystem. The third unit, "The Island of Java," depicts the life of a people who depend on agriculture as a way of living. Finally, the fourth unit, "The City of New Orleans," describes life in an industrial ecosystem. Taken together the units show how different people interact with their environment: Hunters and gatherers adapt to their environment; farmers make some changes in their environment to fit their needs; and people in an industrial city make many changes in their environment that result in major problems. Each of the four units is further divided into five or six sections that deal with coherent themes. At the end of each section a capital letter inside a circle (e.g., Ⓐ) signals students to stop reading and do the appropriate activities.

The Activities

A description of the steps we took in developing the gloss activities provides an overview of the activities:

1. The specific comprehension skills to be featured in the gloss activities were described in terms of behavioral objectives (see Appendix A). The specific skills and objectives are adapted from the four major categories of comprehension skills in the Wisconsin Design for Reading Skill Development (Design) (Otto & Kamm, 1977): Word Meaning (Word Parts and Context Clues), Sentence Meaning (Detail and Paraphrase), Passage Meaning (Central Thought and Relationships/Conclusions), and Sequence.

2. A cognitive map of each unit was constructed to get a "picture" of the important concepts and their interrelationships (see Appendix B for an example of a cognitive map). A cognitive map is a representation of the ideas in a text which shows the main ideas and supporting details and the interrelationships among them.

3. Using the information from the cognitive maps, content objectives which focus on the important concepts and general themes were written for each unit.

4. Guidelines for writing activities were established, and a list of types of activities that could be used as models for helping students develop and apply specific skills as they learn content was organized (see Appendix C).

5. Activities for the four units were constructed with reference to the skills and skill objectives, the content objectives, and the model activities.

a. The activities for the first unit are intended to help students develop awareness and understanding related to the specific skills. In general, the activities in the unit were designed to develop students' understanding of what the skills amount to in terms of behaviors and how to use them.

b. While the activities in the first unit were written to help students acquire an understanding of the skills and how to use them, the activities in the other three units were designed to offer students a variety of opportunities to apply the skills with increasing independence in different contexts. The activities focus on important concepts in each unit and emphasize themes that prevail throughout the text.

6. Small boxes where students could indicate how they felt about their answer to a question were inserted after many of the activities. Students were instructed to put: a + in the box if they were confident that their answer was right; a ? in the box if they were unsure about their answer; and a - in the box if they felt their answer was definitely wrong and they did not know how to find the right answer. The purpose of the confidence rating is to encourage students to think about their own understanding of the text and to become more actively involved in their reading.

7. Brackets were drawn in the margins of the activity sheets so that when the activity sheet is lined up with the text page, the brackets indicate what information should be reread to complete the questions (see Appendix D for examples of text and activities).

Content Test

A 50-item multiple-choice test was constructed to measure students' understanding of the major concepts of the text (see Appendix E). The test is based on the content objectives from all four units and an effort was made to construct items that focused on the important concepts and themes rather than on details in the units. The test is administered after a student has completed all four units of the text.

Skills-application Test

The purpose of the skills-application test is to determine if students who have worked through the gloss activities are better able to use the specific skills in reading another text than those students who did not do gloss activities. For this test, four passages of text and six questions per passage were written (see Appendix F). The text passages vary in length from 165 to 235 words. The content of these passages is based on the life and problems of the Masai people of Tanzania. The six questions for each passage involve asking students to state the central thought, identify supporting details, draw a conclusion, use context clues to determine the meaning of an unfamiliar word, order events in a sequence, and identify an adequate paraphrase. Thus, in responding to the questions a student has an opportunity to apply the skills that were the focus of the gloss activities. The 24-item test provides four possible applications for each skill.

PILOT STUDIES

The prototype materials were tried out in two pilot studies which were designed mainly to examine the useability of glossed materials. Study I was conducted to (a) establish classroom procedures for using the materials, (b) assess students' and teachers' reactions to using the materials, (c) establish procedures for scoring the skills-application test, and (d) determine if students' confidence in answering questions is related to their performance on the content and skills-application tests. Study II was conducted to (a) determine the effect of sustained practice with glossed materials on good, average, and poor readers' performance on the content and skills-application tests, (b) observe how students who had been taught the comprehension skills through systematic skill instruction prior to seventh grade would react to the gloss activities; and (c) compare the performance of students who read the glossed text to the performance of students who read the text and answered review questions at the end of each unit.

Study I

While the design of Study I permitted us to compare the subsequent performance of students who read the text and completed gloss activities and students who read unglossed text, we were mainly interested in working out routines and methodology. One purpose was to observe (a) students' reactions to the content and the reading level of one unit, "The Kalahari Desert," from the Life in Ecosystems text, (b) students' willingness and ability to complete the gloss activities, and (c) students' reactions to the classroom management procedures. A second purpose was to (a) try out the multiple choice test of content knowledge and (b) work out procedures for scoring the skills-application test. A final purpose was to determine (a) the relationship between students' confidence in the adequacy of their answers on the content test and their actual performance on the content test, and (b) whether indicating confidence in their answers to the activities had an effect on students' performance on the skills-application test.

Method

The students who participated in Study I and the procedures that were used are described in the following section.

Subjects. A total of 68 seventh graders participated in Study I. The students comprised three developmental reading classes at a junior high school in a semirural school district in south-central Wisconsin. All three classes had the same teacher. Students' scores on the Cooperative School and College Aptitude Test (SCAT) (1955-1973), administered by school personnel the previous fall, were available from the school records. The SCAT scores were used as a covariate in later analyses. Each class was randomly assigned to one of three treatment conditions: (a) text with gloss activities and directions to indicate degree of confidence in responses to queries (Full Treatment Group, N = 20), (b) text with gloss activities only (Partial Treatment Group, N = 22), and (c) text only, with instructions to read the unit carefully (Control Group, N = 21). Due to absences during the week the study was conducted, complete data were obtained for 66 of the 68 students.

Procedure. The students in all three groups were given a brief introduction to the unit on the Kalahari Desert. The students in the Full and Partial Treatment Groups were given an explanation of the purpose of gloss activities and a demonstration of how to use the activity sheets. The students in both treatment groups were told that when they finished reading a designated portion of the text which was indicated by a circle with a letter in it (e.g., Ⓐ), they were to go to a central location in the classroom and select the activity labeled with the letter that appeared in the circle. The purpose for this procedure was to ensure that the subjects read the text before they attempted to do the corresponding activities. The students in the Full Treatment Group were also shown how to mark the boxes provided for indicating level of confidence in the responses given.

Two investigators shared the responsibility for introducing the materials and explaining the procedures. Following the introductory remarks, the two investigators remained in the classroom to answer procedural questions and to observe students' reactions to the materials and their ability to complete the activities. Most of the students in the two treatment groups required between four and five 45-minute class periods to complete the activities. Each student's work was checked after each class period to determine if the student had been able to follow the written directions. No attempt was made to indicate to the students whether answers were correct or incorrect. However, notations were made on students' activity sheets if they appeared to be having problems following directions; they were asked to contact one of the investigators during the next class period. This was done to ensure that students understood the directions. After each student completed the assigned tasks, he or she took the multiple-choice content test, and then the skills-application test.

Results

On the basis of their observations, the investigators agreed that the students appeared to be interested in the unit. Most of them were able to follow the directions and they worked persistently on the material. Few students expressed any difficulty with reading the material. The classroom management plan of having students go to a central location to get the activities after they finished reading a portion of the text worked efficiently. There was little or no confusion and the movement seemed to provide a welcome break from the quiet reading.

Content test. Students' scores on the 40-item multiple choice content test ranged from 22 to 39 items correct. The combined mean for all groups was 32.75, the mode was 32, and the median was 34. Mean scores were 33.86 for the Full Treatment Group, 30.86 for the Partial Treatment Group, and 33.52 for the Control Group. A comparison of the mean scores using SCAT scores as a covariate showed no significant differences between groups. The restricted range and the high, clustered mean, mode, and median scores indicate that the content test was relatively easy for the entire group of seventh-grade students. The lack of significant differences between the three groups could, therefore, be attributable simply to the fact that the content test was not sufficiently difficult to discriminate reliably among the students.

Students in the Full Treatment Group were also asked to indicate degree of confidence in the correctness of their responses to the 40-item content test. The students could choose one of three confidence ratings (+, ?, -). These judgments about the perceived correctness of an item were correlated on an item-by-item basis with the accuracy of the students' responses. In order to correlate perceived correctness with actual accuracy of a response, the ratings ? and - were considered as a - rating so that the perceived correctness rating was scored as either + or -. The correlations ranged from -.07 to +1.00, suggesting that students had great difficulty assessing the correctness of their responses (r = -.07) for certain items and no trouble at all with other items (r = +1.00).

Skills-application test. One of the purposes of Study I was to develop an accurate and reliable method of scoring items on the skills-application test which required students to write a sentence or short statement (central thought, supporting detail, and context clue items). The scoring team consisted of four reading educators: two graduate students and two Reading Project staff members. The first procedure was to score each student response as right or wrong based on two scorers' careful reading of the text. This procedure was similar to the approach a teacher might use to grade short-answer tests and exercises. A comparison of the scores assigned by the two judges, each of whom scored all 66 sets of responses, showed lack of agreement on the responses to the central thought, supporting detail, and context clue items. For example, the judges disagreed almost 50% of the time on the scoring of the supporting detail items. Because of the lack of agreement, a second scoring procedure was devised. The procedure involves using a list of ideas that must be included in a student's response in order for the response to be scored correct. With this scoring procedure, four judges were able to score five sets of student responses with virtually complete consistency. One judge then scored the rest of the student responses using this system.

Mean scores, based on the scores of the single judge, were computed for all groups. When the mean scores were compared by an analysis of variance, no significant differences were found among the three groups. But when the mean scores were compared with the SCAT scores as a covariate, there were significant differences among the three groups ($F = 3.31$, $p < .05$). A second analysis of covariance revealed a significant difference ($F = 5.984$, $p < .02$) between the combined scores of the treatment groups and the scores of the control group. A regression analysis showed that there were no significant differences between the scores of the Full and Partial Treatment Groups. (The Full Treatment Group rated confidence in the correctness of the responses to the gloss activities. The Partial Treatment Group worked through the activities but did not rate confidence.) The finding of a significant difference between the two treatment groups combined and the control group, and the finding of no significant difference between the Full and Partial Treatment Groups suggests that the gloss activities themselves had a positive effect on students' performance on the skill-application test.

Implications

A number of implications for Study II were drawn from Study I. First, the subjects' positive reactions to the content and reading level of the Kalahari Desert unit suggest that all four units of Life in Ecosystems might be appropriate for seventh graders. Second, as previously mentioned, the content test appeared to be too easy to discriminate effectively among students. Consequently, a new test was written to assess knowledge of all four units and an attempt was made to make the test more difficult. Constructing test items to deal with the important ideas and themes rather than specific details was easier because we decided to test all four units rather than one; and we wrote a total of 50 items. Finally, the significant difference between treatment and control groups' scores on the skills-application test when SCAT scores were used as a covariate suggests that aptitude is a potent variable. This finding indicates that there is a need either to match subjects on an ability or aptitude measure prior to treatment or to continue to use scores from an aptitude measure as a covariate.

Study II

A primary purpose of Study II was to investigate the effects of using glossed materials for an extended period of time with seventh grade students. We wondered if having students work through all four units of the text and giving them more opportunities to apply comprehension skills would help them to develop a habit of active involvement with the material they read. A second purpose of the study was to determine how students who had been taught the selected comprehension skills prior to seventh grade through systematic skill instruction with the comprehension element of the Design would react to the gloss activities. A third purpose was to compare the performance of students who read the text with gloss activities to the performance of students who read the text and then answered short-answer review questions at the end of each unit.

Method

The method used for Study II was based on the procedures that had been developed and used in Study I.

Subjects. The 112 students who participated in Study II made up the entire seventh grade class of a junior high school in a semirural school district in south-central Wisconsin. Due to absences during the 4-week period in which the study was conducted, complete data were obtained for 87 students. The seventh grade teachers assigned the 112 students to one of five classrooms. They attempted to match the students in each of the five groups on scores from the Stanford Diagnostic Reading Test (Karlsen, Madden, & Gardner, 1976), which had been administered by school personnel the previous fall. Students in three of the five groups were randomly assigned to the gloss treatment condition in which they were to read the text and work through the gloss activities. Students in two groups were assigned to a review-questions treatment in which they were to read the text and answer review questions at the end of each unit.

Procedure. The Level G Central Thought and Context Clues criterion-referenced tests from the Design were administered to all students before they began working with Life in Ecosystems. Students' scores on these tests were used to locate very poor performers who appeared to be unable to read the text and successfully complete the treatment conditions, and very good performers who appeared to be too good to benefit from the treatment. All students were introduced to the content of the text. Students in the gloss treatment groups were told that they would be doing some activities designed to help them learn more from the material they read. The gloss treatment groups were also shown how to use the activity sheets and instructed to come to a central location to get the sheets when they finished reading a designated portion of the text. The students in the review-questions treatment groups were told to read each unit carefully and then write answers to the review questions. The style and content of these questions were similar to the type of questions typically found in seventh grade social studies and science texts.

The two investigators who collected the data for Study I were assisted by three graduate students in reading education for Study II. Following the introductory procedures, an investigator or an assistant monitored each group.

A period of 50 minutes was set aside during the morning for the students to read the text and complete the appropriate activities. Each student's work was checked at the end of each period to determine if the students in the gloss groups were able to follow the directions for using gloss. When the students in the review-questions groups finished writing answers to the review questions for a unit, this work was also checked to determine if the students had completed the assigned activities. Students who appeared to be having problems following directions were given additional assistance with the directions during the next class period. After the students completed the assigned activities, they were instructed to take the multiple-choice content test followed by the skills-application test. The students in the review-questions groups completed the work in approximately 8 days while the students in the gloss groups needed from 10 to 14 days to complete the work.

Results

The seventh graders who participated in Study II appeared to be interested in Life in Ecosystems and the treatment group appeared to be actively involved in the process of using gloss. Their teachers commented on the high degree of cooperation these students gave considering the lengthy period of time required to complete the activities.

Content test. The scores on the 50-item multiple-choice content test ranged from 10 to 45 items correct for all subjects and the combined mean for all groups was 36.04. This wider range and relatively lower mean suggest that this content test was more difficult than the one used for Study I. A Spearman rank-order correlation between the odd and even items on the test was .79 suggesting a relatively high degree of reliability. The mean score for students in the gloss treatment (N = 46) was 36.696 and the mean score for students in the review-questions treatment (N = 41) was 35.390. A t-test for matched samples showed no statistically significant difference between the means.

In order to determine if the treatment was effective with average readers, students who scored less than 80% correct on the Design Context Clues test (poor readers) and those who scored better than 80% on the Design Central Thought test (good readers) were excluded from a second comparison of the mean content test scores. After excluding the good and poor readers, 32 students remained in the gloss treatment and 24 students remained in the review-questions treatment. Again, the results of a t-test revealed no statistically significant difference between the mean score of the gloss treatment and review-questions treatment.

Skills-application test. The skills-application test was scored using the procedure developed in Study I. The mean score for students in the gloss treatment was 15.24 and the mean score for students in the review-questions treatment was 16.44. The difference between these mean scores was not statistically significant according to a t-test for matched samples. Again, when the scores of very good and very poor readers were excluded, the difference was not significant.

Implications

An important and consistent finding from both Study I and Study II was that students appeared to have positive reactions both to the text content and to the gloss activities. Teachers also appeared to be enthusiastic about the materials and the gloss approach to helping students apply comprehension skills in content-area material. The results of Study I and Study II also showed that progress had been made in developing a content test that discriminated among students and in developing a consistent method of scoring the skills-application test.

The finding that there was statistically significant differences between the treatment and the control groups in Study I on the skills-application test, but no statistically significant differences between students' scores in the gloss treatment and review-questions treatment on the test in Study II is cause for speculation. One possible reason for the lack of significant differences in Study II is that all students had received Design-related comprehension skill instruction prior to seventh grade. Perhaps the students in both the gloss and review-questions treatments had learned to apply these comprehension skills prior to our intervention with the gloss material. One problem with such an explanation is that the administration of the Design Central Thought and Context Clues skills tests clearly showed that some students had not mastered these skills. And there were no significant differences between groups even when the scores of these nonmastery students were compared. Another explanation for the inconsistent findings from Study I to Study II could be that the students in Study II were simply required to do too much. In Study I the students worked with one unit while in Study II they worked with four. As Rouk (1979) concluded, based on a review of a number of studies of teacher effectiveness, "too much of a good thing can actually be bad for student learning" (p. 6). Perhaps 4 consecutive weeks of almost daily work on gloss activities created an ennui on the part of the treatment group which resulted in poor performance on the skills-application test. The majority of the students in the control group finished in 7 to 8 days and the mean score of the control group (16.44) was higher than the mean score of the treatment group (15.24). Perhaps a delayed skills-application posttest would yield other results.

Taken together, the two studies suggest that the gloss technique is palatable and useable both to teachers and to students. In terms of impact, however, the results are less positive. The lack of consistent impact could be explained in one of three ways: First, we have not yet developed the gloss activities to a point where they can have a consistent measurable effect. Second, we have not yet devised sufficiently sensitive measures of effect. Third, the gloss technique is essentially ineffectual. At the present time we are not prepared to accept the third alternative, partly because we are optimists but mainly because the face validity of gloss and the subjective feedback from the field are good. We will, of course, continue to address the second alternative as we refine our means of assessing effects. But we will most aggressively work with the first alternative as we attempt to refine and improve gloss activities and glossing techniques. The remainder of this paper is devoted to that effort. We seek implications from the substantial and expanding literature that holds promise for such an effort.

RELATED LITERATURE

Fortunately, there is an extensive body of research that appears to be relevant to our efforts to enhance readers' ability to understand expository text. Some investigators have been paying particular attention to readers' prior knowledge and concepts in order to better understand the personal parameters involved in effective comprehension (Anderson, Reynolds, Schallert, & Goetz, 1977; Kintsch, 1979a, 1979b; Norman, Gentner, & Stevens, 1977; Rumelhart, in press; Rumelhart & Ortony, 1977). Other investigators have focused their attention on the analysis of text (Kintsch, 1974; Meyer, 1975a, 1975b, 1979) and the adaptation of text (Frase, 1972, 1975; Rickards & Hatcher, 1978; Rothkopf, 1976) in order to discover and clarify ways to enhance understanding through the manipulation of text and text format. Still other investigators have been examining readers' metacognitive development (Baker, 1979; Brown, 1977, in press; Flavell, 1978a, 1978b; Markman, in press), study skills and learning strategies (Anderson, 1978, in press; Naus & Halasz, 1979), and the effects of schooling (Olson, 1977a, 1977b; Scribner, 1979); and these efforts are particularly promising because they help to clarify the interactions and the potential for interactions between reader and text.

Taken together, the studies related to text comprehension offer a rich--but largely untapped, in any systematic, integrative sense--reservoir of support for developing instructional procedures designed to enhance learning from text.

Our purpose here is to review selected studies that appear to have particular relevance to our efforts. The review is organized to move from a consideration of literature concerned with (a) content-area reading and the suggestions of reading educators for developing students' ability to learn from text, to consideration of three closely related lines of research, each with a distinctive focus on: (b) reader variables, (c) text variables, and (d) the interaction between reader and text.

Reading in the Content Areas

Weiss (1978), in the Report of 1977 National Survey of Science, Mathematics, and Social Studies Education, reports that teachers and administrators express concern because students' inability to read their content texts causes "serious problems in grades 7-12." A total of 49% of the social studies teachers, 40% of the science teachers, and 40% of the mathematics teachers in grades 10 through 12 considered students' inability to read texts to be a major problem. Clearly teachers need to be provided with techniques for helping students read content-area textbooks.

Teaching for Transfer

Carney (1977) has questioned the assumption that students who are taught skills in a reading class will transfer these skills to reading textbooks in content-area classrooms. A skill-centered approach to teaching reading in the content areas is often suggested, and Carney suggests such an approach for content-area classrooms in what he calls functional teaching. According to Herber (1978), functional teaching of reading is "teaching the process students need if they are to understand what you require them to read, as they actually read it" (p. 26). The findings of investigations by Herber and Sanders (1969) offer some evidence that student achievement can be improved if skill-development instruction is integrated with content instruction. Herber (1972) concludes that one way to ensure transfer of skills is to teach reading skills in a context which most closely approximates the context in which the skills are to be used.

Based on the premise that the functional teaching of reading is most effective, Earle (1969) suggests three guidelines for teaching content-area reading:

> 1. teach the process of handling information as well as the information itself;
> 2. offer different amounts of assistance to students with different backgrounds and abilities;
> 3. encourage students to become active participants in learning rather than passive observers of teacher behavior. (pp. 79-80)

Implications

The large percentage of teachers voicing concerns about students' inability to read texts, as reported in the Weiss study, and our own informal interviews with content-area teachers provide sufficient incentive to seek ways to help students improve their ability to read content material. Common sense suggests that the teaching of content and process ought to proceed simultaneously. Herber (1978) says that a dichotomy need not exist between content and process if the content texts and other materials are used as vehicles for teaching both the curricular information and the reading skills necessary to comprehend that information. With additional support from Earle's first guideline (i.e., teach the process of handling the information as well as the information itself), a primary purpose in developing gloss materials should be to provide the help students need in order to effectively use specific comprehension skills as they read content information. Furthermore, gloss activities ought to encourage students to become more actively involved in their own learning (Earle's third guideline) by engaging them in a variety of activities as they read. In line with Herber's (1972) suggestion that teachers should intervene and guide students so that they become aware of the features of text that can be used to help them understand and learn, gloss activities can provide for intervention within the text to show students how to use specific comprehension skills (i.e., context clues, paraphrase, sequence, central thought, supporting details, and conclusions) in order to enhance their understanding of what they read.

The Reader

We have identified two main categories of research and theory with a principal focus on the reader. The first deals primarily with the structure of knowledge that readers bring to the reading act. The second seeks to better understand the development of knowledge structures in individuals.

Structure of Knowledge

A number of investigators have recently been attempting to explain how the prior knowledge of readers affects what they understand and remember (Anderson, 1977; Rumelhart & Ortony, 1977; Schank & Abelson, 1977). While they refer to knowledge structures as scripts, frames, or schemata, the term schema (the plural is schemata) is most frequently used. Norman et al. (1977) describe the structure of schemata as "a framework on which to interrelate different elements of information about a topic into one conceptual unit" (p. 183). Typical examples of schemata are: a schema for a face including slots for eyes, nose, ears, and mouth; and a schema for a birthday party including such elements as presents, birthday cake, ice cream, prizes, games, candles, and singing. Schematic structures are assumed to underlie comprehension, memory, and learning processes. In the discussion that follows we consider theorists' explanations of how knowledge structures guide these processes.

Comprehension. Anderson (1977) states that comprehending a message involves constructing a one-to-one correspondence between the slots in a schema and the various elements in the message. Rumelhart (in press) compares the comprehension process to the activities involved in theory building such as hypothesis testing and evaluation of goodness of fit. In Rumelhart's view, the reader is constantly evaluating hypotheses about the most appropriate interpretation of text. Like a theory, once a schema offers an adequate account of a situation, it becomes a source for making predictions about other unobserved events; thus, the reader can begin to make inferences about new situations which have not yet been observed. On the other hand, Rumelhart (in press) and Rumelhart and

Norman (1978) emphasize the fact that, unlike theories, schemata are active knowledge structures which direct and control the comprehension process. Comprehending, then, is an active process of selecting and verifying the schemata that are most plausible for interpreting the new incoming information. All new inputs must fit in a schema and all aspects of the selected schema must fit with the new incoming information. Since all the schemata available cannot be evaluated each time new information must be processed, only certain schemata that might be appropriate are selected for evaluation.

Rumelhart (1977) suggests two modes for activating the appropriate schemata: top-down and bottom-up processing. Top-down or conceptually driven processing (Bobrow & Norman, 1975) is influenced by a reader's goals and expectations. Top-down processing occurs when the reader makes primary use of higher-order schemata in line with his or her goals and expectations. Bottom-up or data-driven processing (Bobrow & Norman, 1975) involves searching for structures in which to fit the incoming information. Input information enters the system through the most appropriate subschemata, which activates the higher-level schemata. Rumelhart (in press) uses the example of the activation of a face schema to explain these two modes. Top-down processing begins when an individual's schema for human faces is activated to account for incoming information, e.g., the back of a bald head. Continued processing activates subschemata such as mouth, nose, eyes, and ears as expected components of the input required to recognize an acquaintance. On the other hand, if the face schema is activated as a result of incoming information and this leads to the activation of the person schema, then bottom-up processing is occurring.

Memory. Rumelhart and Ortony (1977) suggest that the process of remembering is very similar to the process of comprehending. The relationship, as they see it, is that "memories are natural side effects of the comprehension process" (p. 116). Comprehension involves interpreting sensory inputs by associating inputs with a particular schema. What gets stored in memory is not the knowledge inputs but the interpretation that is given to the inputs as a result of comprehension. Over time, various pieces of the information that have been stored become inaccessible, and only fragments of the original interpretation remain. Remembering, then, amounts to reconstructing memorial fragments into the original interpretation, guided by schemata.

Learning. Norman et al. (1977) define learning as "the acquisition of new cognitive structures (schemata) built upon old, previously acquired structures" (p. 195). Stressing their view that learning is not a unitary process, Rumelhart and Norman (1978) outline three modes of learning: accretion, tuning, and restructuring.

No new schemata are formed during accretion; instead, knowledge is added to existing schemata. The daily accumulation of common facts--lists, dates, phone numbers--takes place by accretion. Norman (1977) suggests the use of mnemonic aides as a useful strategy for learning by accretion.

Learning through tuning involves more than mere addition of knowledge. In the process of tuning, existing knowledge structures are changed to make them more efficient. The ultimate result of this fine tuning and modification of knowledge structures is a stage of "automation" in which less conscious awareness of processing is necessary for performance (Norman, 1977). Tuning does not, however, involve changing the basic relational structure of the schema (Rumelhart & Norman, 1978). What is modified is the individual terms referred to by the schema. Rumelhart and Norman describe three ways in which schema may evolve through tuning:

1. The accuracy of a particular schema can be improved by adjusting or modifying the schema so that it more appropriately fits the situations to which it applies. For example, if students learn that they can add the suffix _th_ to a number to create such words as _fourth_, _sixth_, and _seventh_, they might also extend the rule to form words such as _oneth_, _twoth_, and _threeth_. At this point, the students would have applied the rule too broadly and need to learn the restrictions of its applicability, thereby modifying their schema to more appropriately fit the situation.

2. The schema can be modified by adding a new variable to the schema or by replacing a constant with a variable to make the schema more _generally applicable_ to a variety of situations. For example, children generalize the applicability of their schema for muffins when they extend the schema from only blueberry muffins to all kinds of muffins.

3. Just as a schema can become more generalizeable, the opposite can occur. A schema can be changed by making a variable into a constant

or by specializing the applicability of the schema. For example, children specialize the applicability of their schema for "doggie" from all small animals to just those animals in the group labeled dogs. Norman (1977) suggests that repeated use of knowledge through practice and problem solving are necessary in order for tuning to take place.

Accretion accounts for the addition of new knowledge to existing schemata and tuning explains the modification and improvement of schemata with experience. Restructuring is the learning mechanism that accounts for the formation of new knowledge structures. Rumelhart and Norman (1978) specify two ways in which restructuring can occur: (a) patterned generation--where a new schema is created through modification of an old one, as in learning by analogy; and (b) schema induction--where new schemata are formed to deal with repeatedly co-occuring configurations of two or more schemata, as in classical contiguity learning. Rumelhart (in press) dismisses schema induction as a useful construct; he believes that most learning through restructuring occurs through patterned generation. Norman (1977, p. 41) put it very succinctly: "Restructuring requires good teaching"; that is, it requires the use of good examples, analogies, and metaphors.

Accretion, tuning, and restructuring do not occur in any particular sequence or pattern. "Presumably they co-occur, with the student accreting knowledge about one aspect of a topic while simultaneously restructuring knowledge about other aspects, and conceivably tuning the use of the knowledge about still a third aspect. Still, one expects that over the course of learning about a particular topic, there will be phases in which the mode of learning is primarily of one form" (Norman, 1977, p. 42).

Implications. In discussing the instructional implications of schema theories, Smith (1975) considered some reasons for failure to comprehend and some strategies for addressing the problem. According to Smith, one reason for comprehension failure may be that the reader does not possess the appropriate knowledge structures to interpret a passage. Teachers could begin to deal with this problem by analyzing the subject matter and focusing the reader's attention on the structures and knowledge which are important and generalizable. In addition to analyzing subject matter for purposes of organizing instruction, they could formulate alternative approaches to communicating the important structures and knowledge. A second reason for comprehension failure may be that even though the reader possesses the appropriate structure, it is not accessible as he or she reads a particular passage. To address this problem, teachers need to determine what strategies a reader who fails to comprehend might employ to better understand what is read. Possible strategies are rereading, looking up words, self-questioning, or brainstorming. Once promising strategies have been identified, effective ways to teach them must be devised. Teaching methods could range from simply prompting the use of a strategy, to modeling a procedure, to overlearning a particular strategy through drill. A third reason for comprehension failure may be that there is no knowledge structure to which the material can be related (i.e., the material is incomprehensible). To deal with this problem the teacher would focus on the structure of the text rather than on the individual reader's schema. Smith suggests that teachers analyze the text to determine which elements are important for comprehension and that those aspects of the text be manipulated to help the reader comprehend the information.

In his discussion of schema theory and learning, Norman (1977) also identifies some implications for instruction. He suggests that critical confusion may be a useful notion in effective instruction. He stresses the points that (a) learning is active and the learner must actively construct appropriate knowledge structures; and (b) because effective learning is guided by a purpose, learning must be focused. Norman discusses three techniques for providing this focus. One way is to give students specific problems to solve with the expectation that their attempts to learn to solve the problems will guide the acquisition of knowledge. A second technique, according to Norman, ". . . is deliberately to confuse the student by presenting issues and problems that exceed the student's capabilities. If this is done properly, it should create a guided confusion, confusion in just those critical areas that one then wishes to teach" (p. 46-47). A third technique, which derives from the work in the area of mathemagenics, is to encourage students to reflect on questions which are constructed to provide guidance for interpreting the information as they study given material.

Norman suggests that students be given knowledge not only in what to learn but in how to learn. For example, students might benefit from an awareness of the different skills required in the processes of accretion, tuning, and restructuring and from some training in the use of mnemonic skills. In addition to becoming aware of these general learning strategies, students should be led to understand their own learning styles so they can apply the strategies that will work best for them. Or, in the words of Norman et al. (1977), "Why do we not attempt to teach some basic cognitive skills such as how to organize one's knowledge, how to learn, how to solve problems, how to correct errors in understanding; these strike us as basic components which ought to be taught along with the content matter" (p. 194).

Schema theory offers a view of how knowledge is represented and used by effective readers, and it offers some tentative implications for practice. Of course these implications need fuller development before they can impact either on practice or on achievement. We defer further discussion to the final section of this paper. Meanwhile, schema theory leaves at least two related questions unanswered: (a) How do children acquire knowledge structures? (b) How do their knowledge structures grow and change with age and experience? The work in the area of cognitive development is relevant here.

Cognitive Development

In this discussion of readers' cognitive development, we draw mainly from the work of Brown (1975, 1979), Brown and DeLoache (1978), Naus and Halasz (1979), and Smirnov (1973), a Soviet psychologist, and other Soviet psychologists as reviewed by Meacham (1977). The emphasis in this work, as in existing schema theory, is on the importance of both the reader's activities and involvement, and the reader's existing knowledge for comprehending text. Because cognitive psychologists tend to focus on memory development in order to explain the development of other higher mental processes such as perception, inferencing, problem solving, and comprehension (Meacham, 1977), we will first consider the development of memory as it is explained in theories of cognitive development. Then we will briefly consider how memory and comprehension are related. And finally, we will examine what these theories of cognitive development have to say about comprehension instruction.

Memory development. Cognitive psychologists talk about two types of memory: voluntary and involuntary. In this discussion, the terms voluntary memory and intentional learning are used interchangeably. The same is true for involuntary memory and incidental learning.

When memorization is the primary conscious goal of an action, it is referred to as voluntary memory. The intent to remember is inherent in voluntary memory (Smirnov, 1973); the learner focuses all efforts on retention of the material (Brown, 1979). Voluntary memorization requires both the recognition of and the use of appropriate strategies, which develop with age and experience (Brown, 1979). Flavell (1977) and Naus and Halasz (1979) describe four periods in the development of strategies for remembering: (a) mediational deficiency, where the learner has no knowledge of a strategy; (b) production deficiency, where the learner has the ability to use a strategy but must be directed to do so; (c) production inefficiency, where the learner employs a strategy voluntarily but inefficiently; and (d) optimal production, where the learner spontaneously employs a strategy efficiently in appropriate situations. Students' awareness of the effectiveness of memory strategies develops concurrently with the development of the strategies (see review of Metacognition).

Involuntary memory occurs without an intentional plan to remember; it results from understanding a situation. With involuntary memory, remembering is not the primary goal, but remembering results from learning in a meaningful context (Naus & Halasz, 1979). Postman (1964) describes two main types of incidental or involuntary learning. In the first type, the student learns material to which he or she has been exposed without any explicit directions to learn or remember. Take, for example, a student who is asked to read a passage in order to think of a better way to say the same thing. In reading the passage for such a purpose, the student might not only better understand what was read but also remember it better, even though remembering was not the intent. In the second type, the student learns material to which he or she has been exposed but which is irrelevant to the assigned learning task. An example of this type of learning is frequently observed in adjunct questioning research. Students who respond to postquestions remember information incidental to the questions as well as information relevant to the questions. Within these two types of involuntary memory situations, a meaningful context and an understanding of the material results in learning. Naus and Halasz (1979) emphasize the point that the development of involuntary memory processes depends on changes in semantic memory rather than the use of or changes in use of mnemonic strategies. That is, students who know more can learn more without intentionally trying.

Now we need to consider the interrelationship of voluntary and involuntary memory. Smirnov (1973) has said that the intent to remember is an important condition of remembering (i.e., voluntary memory); but he has also found that when remembering is based on understanding (i.e., involuntary memory), it is more efficient than memorization that is not supported by understanding. Thus, both voluntary and involuntary memory require the active involvement of the learner.

How, then, does the work on memory development relate to the development of comprehension?

Memory and comprehension. According to Brown (1975) the link between comprehension and memory development is inherent in the observation that memory is an automatic product of comprehension. Likewise, Smirnov (1973) views comprehension or understanding as the most important condition for memorization. To make the point that memorization is significantly more productive when it is based on understanding, he quotes some of the subjects he interviewed in his studies of memory and understanding. For example, one subject said: "There was no actual process of memorizing. I did not so much memorize as think and comprehend the material" (p. 129). Meacham (1977), in reviewing the Soviet investigation of memory development, explains that the development of memory abilities depends on the development of other cognitive abilities such as logical or conceptual abilities, self-concept, and comprehension; and, conversely, changes in these abilities are the result of memory development. The processes of remembering and of understanding are inextricably intertwined. Furthermore, both processes proceed best when the learner is actively involved and drawing on his or her entire knowledge system.

Implications. The major implications for instruction suggested by developmental psychologists also revolve around students' active involvement and students' background knowledge (Brown, 1975).

In his book, Problems of the Psychology of Memory (1973), Smirnov also attaches great importance to active intellectual involvement in the development of memory and comprehension. From his interviews with individuals in practical situations, Smirnov identified five activities that students say they use to gain better understanding when their goal is to remember what they read.

1. They develop a plan in which they divide the material into parts, group thoughts, and identify meaningful points.

2. They incorporate and correlate new content with prior knowledge in a manner similar to that described in the discussion of schema theory.

3. Students not only relate information in the text to existing knowledge but they also relate content from various parts of the text.

4. They tend to use imaging as a strategy for remembering.

5. They paraphrase the content of the text into their own language to gain better understanding.

Smirnov emphasizes the point that it is not the result of these activities so much as the process of engaging in them that is important to the development of memory and comprehension. He cautions, however, that not all students are capable of initiating and carrying out these activities on their own, therefore, the teacher must organize the activities for the students and provide the orientation necessary to get them more actively involved in the task. He offers an example in which a botany student is assigned the task of learning to associate leaf forms with the names of trees. To get the student actively involved in learning, the teacher might say "point out the differences and similarities of various forms of leaves, draw a picture of each type, define the leaves of various trees, . . . tell himself about a number of trees he knew which had a particular form of leaf" (p. 264). Smirnov also recommends that teachers build repetition into instruction. Although repetition may have a negative effect when the repetitions are mechanical sequences of the same material, repetition can have a positive effect if it is active, meaningful, and conscious. In a positive application, the repeated actions will not be exactly the same as the preceding ones but be modified in some way. Thus, as a student rereads to improve comprehension, the new reading would not merely repeat the words but seek new interpretations as well. Such positive repetition of activities should lead to a clearer perception of relationships within the text and to better understanding.

In addition to seeking active involvement, teachers are urged to consider students' existing knowledge. Brown (1979) says that notions about the relationship between what is known and what can be known are equally important to developmental psychologists and schema theorists. She and others (Naus & Halasz, 1979; Paris, 1975; Piaget & Inhelder, 1973) emphasize the point that memorization is an active and constructive process which is based upon or determined by the current knowledge and semantic organization of the individual. Smirnov (1973) also stresses the point that what is already known determines the degree of comprehension. He supports his point by quoting interviews with subjects who were required to read and remember texts:

> . . . I tried to connect with something more simple, more familiar. I remembered what I knew from history. I usually do this when I memorize. (p. 143)
>
> . . . I more often went beyond the limits of the text.
>
> . . . I relied on what I already know of microorganisms. (p. 144)

Brown (1975) concurs in stating that the degree of understanding and the strength of ultimate retention is very closely tied to what is already known. She outlines two requirements for comprehending and subsequent remembering: (a) the material must be meaningful, and (b) the material must be compatible with the learner's existing knowledge structures. Brown calls this latter requirement a case of "headfitting." Those who plan instruction, then, must be concerned with "headfitting" (Brown, 1979). If teachers want students to perform in a way that is different from how they performed in the past, they must begin instruction or training "where learner's heads are." This is in line with developmental psychologists' conclusion that the success of training depends on the distance between a student's existing knowledge and the new information to be learned.

What does "headfitting" have to do with getting meaning from text? Brown (1979) suggests a "task by head" interaction, where meaning results if there is a "fit" between new information and the prior knowledge and goals of the learner. In her investigations of memory performance, Chi (1978) infers from her findings that knowledge about the stimuli rather than capacity or strategy may be the major factor in the age differences observed in developmental studies. From her perspective developmental differences are viewed as differences between experts and novices. Brown (1979) puts it this way: "It is not how old your head is but how much it has experienced in a particular cognitive domain" (p. 253).

Chi's finding that knowledge of stimuli may be an important factor in development suggests that students need to develop a schema for texts. We have already described schemata as a way of representing knowledge, yet we have not considered how knowledge is typically represented or what students might come to know about the important features of text. In the next section we address these issues.

The Text

Scholars have developed several text-representation systems which have been useful in their studies of comprehension and memory for spoken and written discourse. Although each system was developed for different research purposes, all of them address a common need for ways to represent the meaning and structure of information in texts. In general, the systems are used (a) to assess the amount and type of information learners remember after reading and (b) to identify the meaning characteristics of texts which might influence the way in which they are comprehended. Our purpose here is to describe types of information that are represented in text and to consider how representation systems can be used to stimulate comprehension processes.

Rumelhart (1975) and others (Mandler & Johnson, 1977; Stein & Glenn, 1978; Thorndyke, 1977) who have attempted to test Rumelhart's model of comprehension empirically have characterized the schemata used to encode information in the form of a story grammar. These researchers have concentrated on top-down or conceptually driven processes, and the grammars they developed are designed to specify the meaning and global structure of texts used in experimental investigations of prose comprehension (Rumelhart & Ortony, 1977). The texts used in these studies are simple stories and fables which conform to the grammars, and the researchers manipulate the structure of the texts to explore how knowledge of the conventions of a typical story affect comprehension and recall. Implications for applicaton are limited by the fact that most of the texts students encounter in school settings do not conform to the structure of simple stories.

Kintsch (1974) and Meyer (1975b) have developed formal systems for representing the meaning of texts that are not limited to passages which have conventionalized story structures. Kintsch's representation system is part of a theoretical model of memory and memorial processes (Kintsch & van Dijk, 1978). All of this is an attempt to provide a general theory of text structure and a formal characterization of the role schemata play in text comprehension and recall. Meyer's system includes detailed procedures for analyzing texts into global, logical or rhetorical structures; but she used Kintsch and van Dijk's (1978) theory to explain the results of many of her studies because her procedure is not tied to an independent theoretical model of comprehension. We have, therefore, selected the representation system underlying Kintsch and van Dijk's model as the focus of this review.

The Kintsch and van Dijk (1978) model of comprehension provides a framework for describing the problems students encounter when they are asked to read expository materials. The model is based on a prose representation system which consists of lists of propositions (idea units). Kintsch's representation system is easier to use than a network system such as Rumelhart's because it can be applied to texts of any length or structural form. The processing model described by Kintsch and van Dijk (1978) and the results of their research are consistent with conventional notions that the comprehensibility of a text depends upon students' familiarity with the content of the text, their purpose for reading, and their skill at deriving meaning from different types of texts.

"Bottom-up" processes are emphasized in this model in that comprehension is viewed as the gradual, inductive construction of meaning from a detailed (propositional) level to a global (gist) level of understanding (Johnson & Mandler, 1979). Within Kintsch and van Dijk's model, texts are represented at three levels: a microstructure, a macrostructure, and a "super-structure" level. Each level of representation is integral to their comprehension model, so we will briefly describe them before we discuss the comprehension model and its implications for reading education.

Representing the Meaning of Texts

According to Kintsch (1974), a text can be analyzed into a structured, connected list of propositions that represents the underlying semantic meaning and meaning relationships of the text. This connected list of propositions represents the *microstructure* of a text. The microstructure is the lowest level of analysis and includes all the detailed propositions (concepts or ideas) in a text base. A *text base* is a theoretical, idealized representation of the meaning of a text as it might be represented in memory. *Macrostructures* are part of this text base, and they represent the gist of a text. Macrostructures consist of hierarchical, connected lists of propositions which are assumed to be the result of certain psychological operations specified in the model of comprehension proposed by Kintsch (1979a) and Kintsch and van Dijk (1978). Macrostructures can range from a statement as long as an abstract or summary of a text to a statement as short as the title of a text. At the lowest level of the macrostructure, propositions are connected on the basis of the logical or rhetorical relationships which exist among the ideas in a text base. This level of the macrostructure is called the *fact* level of representation. Fact relationships are signaled in the surface form of a text by such natural connectives as "and," "but," "however," or "because." Fact relationships need not be explicitly stated in a text, but they must be represented in a text base representation of the meaning of a text. Kintsch and van Dijk (1978) have not specified the fact level of representation in much detail, claiming that theory adequate to deal with the logical or rhetorical structures in texts has not been developed at this time. They do state, however, that this level of representation is similar to the types of rhetorical relations described by Grimes (1975) and investigated by Meyer (1975b, 1979), as well as to the knowledge structures and conceptual dependency system developed by Schank and Abelson (1977).

Whereas macrostructures define the global content or meaning structure of a text, super-structures, or schematic structures, define the global syntactic structure of the text. Super-structures assign specific functions or roles to the macropropositions of a text base (van Dijk, 1977a, 1977b). According to Kintsch (1976) and van Dijk (1977a, 1977b) there are many different types of texts, so there are many different types of super-structures. The two types of structures that have been investigated by Kintsch and his associates (Kintsch & Green, 1978; Kintsch & Kozminsky, 1977; Kintsch & van Dijk, 1978) are conventional story structures and psychological research report structures.

Kintsch and associates (Kintsch, 1979a; Kintsch & van Dijk, 1978; Kintsch & Vipond, 1978) are using the microstructure, macrostructure, and super-structure levels of representation to develop a model of prose comprehension and recall which can be used to determine what makes a text easy or difficult to read and what information in the text will be remembered after reading. The model is designed to account for both comprehension and recall processes, but the comprehension processes are emphasized in this review.

Theoretical Model of Comprehension

Kintsch (1978) defines comprehension as a constructive process in which a reader uses the stimulus characteristics of a text, prior knowledge, and the situational context to create a response to a text. Operationally, comprehension is defined as the construction of a coherent text base in memory. This text base is represented in the form of a connected graph.

To simulate comprehension processes and to predict what information will be recalled after reading, readers are assumed to use two kinds of schemata: knowledge of the structure of the type of text to be read and knowledge of goals and purposes for reading that type of text. Both kinds of schemata constrain the control processes within the model.

The first type of schema, knowledge of the structure of texts (i.e., knowledge of types of super-structures), specifies (a) the global categories of information to be found in certain types of text, and (b) which information in each category is relevant to forming the macrostructure of a text. For example, subjects who are asked to read a psychological research report are expected to know that (a) such reports are divided into the categories of introduction, method, results, and discussion sections, and (b) they can expect each section to contain information relevant to the caregory that labels it (Kintsch & van Dijk, 1978). The model can be used to make reliable predictions only if readers are assumed to have such conventional top-down knowledge.

The second type of schemata in the model, the readers' goals and purposes for reading, establishes expectancies within the reader for determining which information is relevant in a text and which information must be inferred because it is not explicitly stated. Kintsch and van Dijk (1978) stress the importance of being able to specify the reader's goal schema, as this type of schema can override the structure of a text in determining what information will be remembered after reading. For example, students who are asked to skim a psychological research report for some special purpose would come up with a different macrostructure representation for the report than students who read the article carefully for recall purposes.

Given these two types of assumed schemata, Kintsch and his associates can simulate the way in which information in a text might be comprehended and remembered by a specified group of readers with a specified purpose for reading.

Simulated Processing Cycles

The model assumes a limited-capacity working memory buffer in which sentences are initially processed on a clause-by-clause (serial or bottom-up) basis. In the working memory buffer, propositions are processed into a coherence graph or macrostructure by connecting propositions which share a common argument and by connecting or grouping propositions together which belong to the same fact structure. Macro-operators are applied to this graph to construct new (inferred) propositions, to delete irrelevant propositions, and to generalize redundant propositions, thereby forming the macrostructure of the text.

Within the working memory buffer, syntactic and phonemic information from the text is analyzed simultaneously (in parallel) with the semantic or propositional information from the text. The model assumes that syntactic and phonemic analysis processes require less attention from skilled readers. This aspect of the model reflects levels of processing notions (cf., Craik & Lockhart, 1972) in that macro-operations represent a deep or semantic level of processing which results in greater understanding and memory for texts than syntactic or phonemic levels of processing. The size of the working memory buffer is a major parameter of the processing model; the number of propositions which can be processed varies for different readers, depending upon their level of skill development and familiarity with the content of the text being read.

Once the first clause is processed, some of the propositions are selected for retention in working memory to relate them to incoming information. The propositions retained in working memory are selected on the basis of their (a) recency (i.e., the last proposition processed) and (b) height in the preceding graph; superordinate propositions are assumed to be selected for retention in working memory more frequently than subordinate propositions. The hypothetical strategy of selecting superordinate propositions for retention in the buffer could vary depending upon the readers' goals and purposes for reading.

If the propositions from a second clause cannot be connected with the propositions in a newly constructed graph, a reinstatement search is initiated whereby the reader searches through information from the first clause stored in long-term memory to find a proposition with which the new information can be connected. If this search fails, a new subgraph is formed and an inference must be made to connect the two graphs. According to the model, propositions which occur in succeeding subgraphs, either by retention or by reinstatement search, are more likely to be recalled than other propositions because of the frequency and amount of processing they receive. The probability that a given proposition will be recalled is another important parameter of the model that is determined through examination of the text base representation and simulated processing cycles.

The processing model and representation system were developed to describe how readers comprehend, store, and remember information from texts. The model yields simulated recall protocols for a text which can be compared to the protocols of subjects who are asked to read and recall the text; thus, it can be used to predict (a) the frequency with which propositions will be recalled, and (b) certain inferences that will be made by subjects who read the text. Predicted and observed frequencies can be subjected to statistical goodness-of-fit chi square tests to determine how well the model predicts actual comprehension and recall performance.

Implications

Kintsch and his associates have discussed some ways in which their text representation system and processing model could be used to address practical matters like the readability of text, performance differences between good and poor readers, and effective placement of adjunct questions to improve learning from texts. While Kintsch and his associates do not claim that their ideas are particularly new to teachers, they do believe that their model provides a new and perhaps more objective way to characterize the effects of prior knowledge and the effects of text characteristics on learners' ability to understand and remember information from printed materials.

Kintsch and van Dijk (1978) and Kintsch and Vipond (1978) argue that readability cannot be considered a characteristic of a text alone. Using the processing model, they illustrate how readability, or comprehensibility, can be viewed as an interaction between readers and texts.

Specifically, they show how a measure of the number of reinstatement searches and the number of inferences predicted by their model for a given text can be used to improve estimates of text difficulty. Texts which require many inferences or long-term memory searches are presumed to be more difficult to read than texts which require fewer inferences or searches. Inferences and reinstatement searches are assumed to interrupt automatic comprehension processes and thereby result either in increased reading times or in lower comprehension scores. Because the number of propositions that can be processed in each cycle and the capacity of working memory are major parameters of the model, students who are unfamiliar with the content of a text would have to devote more reading time to smaller units of the text and to forming inferences; or, they would simply be unable to understand the text because they are not able to form the appropriate inferences. Thus, Kintsch and Vipond (1978) suggest using a combined measure of reading time and comprehension performance as an index of text difficulty rather than traditional types of readability measures.

The model also offers a different means of conceptualizing differences between good and poor readers which compliments the LaBerge and Samuels (1974) model of automaticity. According to the model, students with poor decoding skills, low vocabulary knowledge, or limited experience with the syntax and global structures of written language must devote processing resources to low-level syntactic or phonemic operations; they have difficulty understanding a text because they are unable to process the information at a semantic level of analysis. The model also demonstrates the difficulty students experience when they are unfamiliar with the conventions of how texts are typically organized. These students may adopt an unusual selection strategy for retaining propositions in working memory. Their understanding of a text may not be the same as that of other students because the information they use to connect ideas may be different from that of other students.

Kintsch (1979a) has used the processing model as a basis for speculating about the effects of adjunct questions on comprehension. He argues that the apparent conflicts in the results of many adjunct-aid studies may be due, simply, to a general lack of knowledge about comprehension processes. He uses his representation system to illustrate how adjunct questions might have positive, negative, or null effects depending upon (a) where they are placed in a text base, and (b) what types of information they tap. For example, questions that require students to relate textual information to something they already know presumably will produce a positive effect. Such questions should help students set up appropriate expectations about the new information they encounter as they read. Positive effects would also be expected if questions are placed in the text at points where they help students reinstate information that is needed to relate new ideas in the text to information they have already read. Asking questions about irrelevant details, however, would be expected to produce negative effects because the questions would set up inappropriate expectations for processing the remaining text. Questions which require only that students use information that is in their working memories would be expected to produce an overall null effect. Such questions would not help students either to set up appropriate expectations or to relate ideas from various segments of the text. Null effects might also be obtained because questions about information that is in learners' working memories evoke a shallow level of processing; that is, the questions do not require students to devote processing resources to connecting and relating important information.

To summarize, the model of comprehension proposed by Kintsch and van Dijk (1978) is a system for representing the meaning of a text and certain psychological operations which act on the representation system in cycles. These operations yield a coherent macrostructure representation of the meaning or "gist" of a text as it might be represented in memory. The representation system and processing cycles refer to an idealized picture of the way in which texts are comprehended, and Kintsch (1979b) cautions that there is no such thing as "the" meaning or macrostructure of a text: readers with varying amounts of related prior knowledge and with different goals for reading would apply the macrooperations of the model differently, thereby, producing a "family of possible macrostructures for any given text" (Kintsch, 1979b, p. 221).

Schema theory, theories of cognitive development, and text representation systems underscore the importance of students' prior knowledge and active involvement in understanding text. In the next section, we review two areas of research that seek procedures for helping students become actively involved in learning from texts.

The Interaction of Reader and Text

The work we have examined up to this point tends to focus either on the reader or on the text; but some of the related work seems most clearly to focus on the interaction of reader and text. The latter may offer the clearest implications for developing procedures to help students understand and learn from text. In this final section we consider two areas of research on the interaction of reader and text: research on mathemagenic behaviors and research on metacognition.

Mathemagenic Behaviors

The results of studies related to readers' mathemagenic behaviors lend additional support to the notion that students' active involvement in the reading task is a primary requisite of effective reading performance. In defining mathemagenic behaviors as behaviors that produce learning, Rothkopf (1971) emphasizes the point that what the student does in the learning situation is probably very important in determining what will be remembered. Studies of mathemagenic behaviors, then, involve the manipulation of text through the use of adjunct aids in order to influence students' behavior while reading. Adjunct aids, according to Vacca (1978), "may be thought of as 'orienting directions' (Frase, 1970) which dispose the reader to respond actively to certain aspects of text" (p. 222).

Three types of adjunct aids that have been used to influence students' behavior in the learning situation are: (a) advance organizers, which are intended to help students relate new information to their prior knowledge; (b) objectives, which provide students with the main points to be learned from the material; and (c) questions, which are inserted in the text to direct students' attention to aspects that are considered important.

Advance organizers. The purpose of an advance organizer, as conceptualized by Ausubel (1978), is to provide a means for linking the reader's prior knowledge with new information provided in the text. The advance organizer provides a preview (either written or oral) of text content in the form of either an introductory prose passage or a diagram that employs key vocabulary to show the text structure. Ausubel reports that his particular prose advance organizers facilitate the learning of lower-ability students, whereas higher-ability students do not seem to need additional assistance in relating new information to previously acquired knowledge (Ausubel, 1960; Ausubel & Fitzgerald, 1961, 1962; Ausubel & Youssef, 1963).

Results from other studies that have followed Ausubel's line of research are not in complete agreement regarding the effects of advance organizers (Barnes & Clawson, 1975). To explain these discrepancies, Rickards (1975-76) suggested that a prose advance organizer presented before reading might pose such a difficult memory task that the reader is unable to recall information from the organizer in order to use it in learning the new material. Rickards found that short prestatements interspersed in the text led to significantly improved comprehension. In reviewing the research on advance organizers, Faw and Waller (1976) speculated that the inconsistent effects of advance organizers might be attributable to the use of poorly constructed organizers that did not meet Ausubel's specifications.

Several studies have been designed to investigate the effectiveness of another type of advance organizer referred to either as a structured overview or a graphic advance organizer. Investigators have suggested that such organizers might circumvent some of the problems of the prose advance organizer. Estes, Mills, and Barron (1969) define a structured overview as: "a visual and verbal representation of the key vocabulary of a learning task in relation to more inclusive or subsuming vocabulary concepts that have previously been learned by the student" (p. 41). They point out two functions of the structured overview: (a) it provides a structure for teaching vocabulary in content subjects, and (b) it helps students relate new information and concepts to their existing knowledge. Barron (1972) claims two advantages of the graphic advance organizer over the prose advance organizer. First, standard directions have been worked out for constructing a graphic advance organizer. Second, while prose organizers are to be read by the individual students, the presentation of a graphic organizer involves a verbal discussion between the teacher and students; therefore, a teacher can immediately assess the appropriateness of an organizer for the students' background knowledge.

Although the results of investigations of the effectiveness of the structured overview have been inconclusive, they tend to favor the structured overview over other treatment or control conditions. Earle (1969) found that teachers' reactions to the structured overview were positive and that they were able to construct and use structured overviews quite effectively. Estes et al. (1969) studied the effectiveness of the structured overview with ninth grade English classes and found no significant differences among four groups which got (a) a prose advance organizer, (b) a structured overview, (c) purpose questions, and (d) no introduction. When they compared similar treatment groups in a tenth grade biology class, they found significant differences favoring the structured overview group. Estes (1972) found no significant difference between a prose advance organizer group, a structured overview group, and a control group; but a direct comparison of criterion score means showed that the structured overview group performed slightly better than the advance organizer group at each of four reading ability levels. Estes concluded that the consistent results across ability levels suggest that the structured overview and the advance organizer may have similar effects on reading comprehension. Barron (1972) also found no significant differences between a graphic organizer group, a prose organizer group, and a control group at grade levels 6 to 12. Walker (1979) wondered whether a graphic organizer used with social studies materials over a long period of time would affect fifth and seventh grade students' acquisition of vocabulary, paragraph meaning, and social studies concepts. She examined two types of graphic organizers: (a) an intrinsic organizer which shows relationships inherent in the content, and (b) an extrinsic organizer which imposes a structure of study skills and general social studies concepts upon the content. She found that both graphic organizers were more effective as preteaching strategies than a modified SQ3R treatment or a "no prescribed preteaching" treatment. Walker also looked at the effect of combining the two graphic organizer approaches. She found that following the extrinsic organizer with the intrinsic organizer was better than the reverse order and that this combination was especially effective with students of relatively low ability (IQ equal to or less than 105).

In an attempt to find an explanation for seemingly inconsistent results, Barron (1979) questioned some of the students who had served as subjects in the experiments reviewed above. He discovered that the students who thought the overview had helped them learn "took an *active* role in the reading-learning task, they attempted to consciously relate the new specific information to the teacher's introductory presentation" (p. 173). As a result of this insight, Barron (1979) decided to teach students how to construct their own structured overview in order to get them more actively involved in their reading. Although he cites no specific research studies, he says that students who constructed their own structured overview have scored higher on posttests than those students who received a structured overview made by the teacher. Dana (1980) investigated the effect of a graphic organizer designed to require students to fill in intentionally deleted information as they read. The graphic organizer, then, serves as (a) an advance organizer, (b) a study aid during reading, and (c) an aid to review before a test. Dana found significant differences favoring the graphic organizer group over the control (read only) group when she compared their scores on a multiple choice content test which was given immediately after the treatment and a delayed short-answer test. On the other hand, Pederson and Moore (1979) found no significant difference in the performance of students who (a) constructed their own structured overview, (b) constructed prequestions, (c) constructed postquestions, or (d) merely read the passage twice. Further study is needed to resolve the apparent conflict between the last two studies. Apparently the nature of the student involvement is a critical factor that must be understood more clearly before it can be manipulated effectively. Likewise, based on Dana's results, the nature of the text is also a factor that merits further study. Dana found that the use of a graphic organizer affected comprehension performance when students were required to read several units of a text with more than one theme, but did not affect performance when students read only one unit with one major theme.

Instructional objectives. According to Gagné (1977), instructional objectives provide clear goals that enable students to organize their learning and to reduce the time wasted on irrelevant information. Results from several studies of the effects of objectives indicate that objectives (a) generally enhance the learning of content which is directly related to the objectives, and (b) are most effective when interspersed throughout the text rather than presented together in either a pre-, post- or intratext position (Frase & Kreitzburg, 1975; Gagné & Rothkopf, 1975; Kaplan, 1974; Kaplan & Rothkopf, 1974; Kaplan & Simmons, 1974; Rothkopf & Kaplan, 1972).

In their review and critique of mathemagenic research, Faw and Waller (1976) add a third general finding from the studies conducted: Incidental learning is unaffected by objectives although results show that it decreases with an increase in the length of the passage. Kaplan and Simmons (1974) found that the use of objectives will affect students' learning differently as a result of the interaction between the amount of information given in an objective and the location of the objective in the text. Duchastel and Merrill (1973), in a review of the function of objectives, suggest two reasons why objectives are not always effective as aids to learning: (a) too many objectives presented at one time may confuse and overwhelm students, and (b) objectives are not likely to be effective if students do not attend to them.

Questions. Results from investigations of the effectiveness of questions as adjunct aids show that either postquestions or prequestions generally enhance learning; however, only postquestions seem to aid incidental learning, that is, acquisition of knowledge not directly related to the questions (Boyd, 1973; Frase, 1967, 1968; Frase, Patrick, & Schumer, 1970; McGaw & Grotelueschen, 1972; Rothkopf & Bisbicos, 1967; Rothkopf & Bloom, 1970; Snowman & Cunningham, 1975). Studies of question placement (Boker, 1974; Rothkopf, 1966; Rothkopf & Bisbicos, 1967) indicate that questions interspersed after short sections of text shape a reader's attention and processing activities and produce a generally positive learning effect. Prequestions, however, limit the range of material learned by focusing and limiting the reader's attention to specific portions of text. Frase (1967) examined question frequency and found that frequent prequestions tend to inhibit the learning of content that is not questioned.

In a study of meaningful-learning questions, questions that require students to organize facts into a super- and subordinate scheme, versus rote-learning questions, questions that require literal recall of a single word or fact but do not require students to relate ideas, Rickards and DiVesta (1974) found that frequent meaningful-learning questions enhanced total recall. Rickards and Hatcher (1978) found that meaningful-learning questions were more effective than rote-learning questions in enhancing poor readers' comprehension and recall but neither type of question affected good comprehenders' performance. The investigators concluded that good readers may automatically relate topically similar facts and therefore not need meaningful-learning questions to aid their comprehension and recall. Shavelson, Berliner, Ravitch, and Loeding (1974) did not find a significant interaction between question position and question type, but they did find that students who received higher-order questions scored significantly higher on both immediate and delayed-retention tests than students who received lower-order questions. In their study, question type was based on Bloom's (1956) taxonomy; higher-order questions focused on Bloom's comprehension, application, and analysis categories and lower-order questions focused on his knowledge-level category. Results from studies by Boker (1974), Hiller (1974), and Swenson and Kulhavy (1974) suggest that answering questions has a positive effect on both immediate learning and retention of content.

Implications. Research on readers' mathemagenic behaviors focuses on getting students actively involved in their reading through the use of some type of adjunct aid. The three most commonly used types of adjunct aids are advance organizers, objectives, and questions. Studies of the effectiveness of the advance organizer as a preview of text content have produced inconsistent results. Because students may have memory-related difficulties when they read a long prose passage before they read a text, short prestatements like the ones Rickards inserted within the text or graphic advance organizers that must be completed as students read a text may be more effective adjunct aids than Ausubel-type advance organizers.

Studies consistently show that objectives enhance the acquisition of content related to the objectives and that they are most effective when they are interspersed within the text.

Faw and Waller (1976) conclude from their review of investigations of adjunct aids that inserted questions seem to offer the most promising method for getting students actively involved in their reading. Rothkopf (1972) and Kintsch (1979a) (see section on the Text), however, caution that using questions may not be an effective instructional strategy. If questions are not related to the important information to be learned, then they may result in study activities that have no effect or even a negative effect on the desired learning outcome. Only questions which elicit student activities that are important to achieving particular instructional objectives are likely to have a positive effect on learning. Furthermore, there is evidence that even meaningful learning questions may be effective only with certain types of learners, e.g., poor comprehenders.

In general, the studies of mathemagenic behaviors deal with techniques that teachers can use to enhance students' interactions with text. In studies related to metacognition the focus is on the learner's own awareness of that interaction process.

Metacognition

Metacognition is a construct from developmental psychology that provides a framework for examining various aspects of cognitive behavior.

Metacognitive knowledge is the knowledge one has about one's own cognitive processes in terms of awareness and appropriate use of the processes (Brown, in press). Metacognitive knowledge and insights are assumed to underlie the ability to control one's own mental activities in order to solve a problem or attain a cognitive goal like understanding written material. The construct was formulated by Flavell (1976), who was investigating the development of children's awareness and control of their own memorial processes. Some scholars are now using the construct to examine the development of social cognition, self-regulation, intelligence, and problem-solving behavior (Borkowski, in press; Campione & Brown, 1978; Flavell, 1976, 1978a, 1978b; Meichenbaum & Goodman, 1980; Mischel, 1979; Sternberg, 1979). And, most important for our purposes, others are using the construct of metacognition in their studies of children's ability to comprehend, study, and learn from texts (Baker, 1979; Brown, in press; DiVesta, Hayward, & Orlando, 1979; Markman, in press; Yussen, Mathews, Buss, & Kane, 1979).

In view of current ongoing research, especially that of Brown and her associates, the construct promises to be useful in (a) supporting current conceptions of reading and reading instruction, and (b) shedding new light on the nature of reading difficulties and effective instructional practice (Brown, in press; DiVesta et al., 1979; Markman, in press). Furthermore, the construct of metacognition has an attractive, positive appeal. It is consistent with conventional notions of the types of decision processes students seem to engage in when asked to study and learn from texts; and metacognitive activities are the types of "debugging" or self-regulatory activities (Norman et al., 1977; Resnick & Glaser, 1976) that are suggested to help students improve their ability to comprehend and learn from texts.

In this section we discuss (a) some categories of metacognitive knowledge that are assumed to underlie skilled reading performance, (b) ways in which metacognition is thought to develop through formal and informal instructional experience, and (c) implications from related investigations for improving students' ability to learn from texts.

Categories of metacognitive knowledge. Brown (cited in Wertsch, in press) divides metacognitive activities into two broad categories. The first category includes reflective or introspective knowledge about one's own cognitive abilities and activities. Flavell (in press) refers to knowledge or insights of this type as *person variables* or *metacognitive experiences*. *Person variables* are the knowledge and beliefs people have about themselves and others as learners, their strengths and limitations. For example, most people have some notion about their ability to read, solve math problems, or take tests. *Metacognitive experiences* are subjective feelings, ideas, thoughts, or sensations that arise during active attempts to solve problems or comprehend. They are insights such as feelings of confusion or feelings of understanding, that students can use to monitor and to modify their behavior when they have difficulty understanding a text or solving problems.

Brown's second category includes the knowledge students use to control, regulate, or modify their behavior during active attempts to learn or comprehend. Flavell (in press) and Flavell and Wellman (1977) divide this category into subcategories of sensitivity, task variables, and strategy variables. Within the sensitivity category, Flavell (in press) suggests that students could develop knowledge about the depth and kind of cognitive processing that is appropriate to given tasks. For example, they could learn when it is important to read a text carefully, when to skim, and when to reread. Task variables include the aspects of a task that affect the ease or difficulty with which it can be accomplished. Flavell (in press) suggests that students ought to be aware (a) of how the amount and kind of information they are expected to process affects the way they should approach a task, and (b) that some tasks are more easily accomplished than others. For example, students ought to be aware that short texts take less time to read than long texts and that organized texts or texts with familiar material are easier to read than disorganized texts or texts with unfamiliar content. Strategy variables include the kinds of activities students can perform to meet task demands. Essentially, this category has to do with the decisions students make about which strategies are appropriate for accomplishing a given task. Brown (1977, in press) has described several decision-oriented metacognitive skills students could develop and use before reading (predicting and planning), during reading (checking and monitoring), and after reading (reality-testing). She lists seven examples of reading-study activities which she believes involve metacognitive decisions:

a. clarifying the purposes of reading, that is, understanding the task demands, both explicit and implicit,

b. identifying the aspects of a message that are important,

c. allocating attention so that concentration can be focused on the major content area rather than trivia,

d. monitoring ongoing activities to determine whether comprehension is occurring,

e. engaging in review and self-interrogation to determine whether goals are being achieved,

f. taking corrective action when failures in comprehension are detected, and

g. recovering from disruptions and distractions (Brown, in press, p. 4 of prepublication copy).

These are the types of skills reading educators describe when they talk about study-reading, and they are types of skills students presumably use when they are expected to read and study texts independently. Such skills presumably are applied when self-generated (metacognitive) decisions are made during the process of reading and studying; they ostensibly enable students to plan, monitor, and control their own reading-study behavior.

Flavell (in press) makes the important point, however, that the metacognitive knowledge that turns out to be most useful to a student is knowledge of how person, task, and strategy variables interact to affect learning, e.g., a student's awareness during a reading-studying activity that "this is a difficult text; the teacher gives detailed tests; I need to read carefully and remember the important facts." Most of the scholars who are working with the development of metacognition (Brown, in press; Borkowski, in press; Flavell, 1978b; Markman, in press) agree that active, goal-oriented attempts to learn can trigger and enhance metacognitive forms of knowledge and experience, and that metacognitive insights can, in turn, trigger and enhance successful learning experiences.

Instructional issues. Two questions must be considered before we examine implications for instruction: (a) Can metacognitive activities be used consciously? (b) How do forms of metacognitive knowledge develop? There are tentative but positive answers for both questions.

Neither Brown (in press) nor Flavell (1978b) believes that metacognitive knowledge or skills are always used at a conscious level; but they do assume the knowledge and skills (a) are accessible to introspection, and (b) may be brought to a conscious level by deliberate attempts to learn, solve problems, or overcome comprehension difficulties. Flavell (1978b) contends that people are able to introspect about the forms of metacognitive knowledge and experience that he has described because these forms of knowledge and skill are acquired through life experiences, particularly through schooling or formal educational experiences like learning to read and learning to write.

The issue of whether students can indeed introspect about metacognitive forms of knowledge is important to developmental psychologists because some of them have argued that young children and novices are not able to introspect about these forms of knowledge. Hence, a basic hypothesis of scholars who use the metacognition construct is that the increasing, voluntary control and regulation of learning strategies demonstrated by experts and older students is a result of the development of metacognitive knowledge from a level of unconscious acquisition of that knowledge to a gradually increasing, conscious control over that knowledge (Brown, in press; Brown & DeLoache, 1978). For instance, students first acquire a "tacit" or unconscious knowledge of how texts are structured; with age and experience, this knowledge is explicitly, consciously, and deliberately used by students to guide their comprehension and study behavior (Brown & DeLoache, 1978; Markman, in press). Yet, while there is general agreement that metacognitive development results from formal or informal instructional experiences (Borkowski, in press; Brown, 1977), Werstch (in press) has criticized studies in the area for failing to address the important role of instruction in the development of metacognitive skills.

Implications. Norman et al. (1977) suggest that students be taught "some basic cognitive skills such as how to organize one's knowledge, how to learn, how to solve problems, and how to correct errors in understanding" (p. 194). They feel that helping students learn how to correct errors in understanding, or how to "debug" their own knowledge, may be more important than teaching content or knowledge per se. Metacognitive activities are types of "debugging" activities which many believe can and should be taught. The fact is, however, that it is easier to suggest that students should be taught "debugging" strategies than it is to develop specific techniques for teaching such strategies. Nevertheless, there is some evidence that it is possible to teach developmentally disabled students certain types of metacognitive strategies (Campione & Brown, 1978). General suggestions about what might be taught to improve metacognitive skills do exist (Brown, 1977, in press).

Brown and Campione (1977, 1978) trained a group of retarded students in a simple checking and monitoring strategy for memorizing lists for rote recall purposes. The procedure involved training students to use a self-questioning strategy to estimate their readiness for recall. The training effect was significant in that the students were able not only to maintain the strategy but also to generalize the strategy to gist recall of a story. Borkowski (in press), Brown and Campione (1978), and Resnick (1976) all suggest that self-interrogation and self-monitoring strategies might prove effective for enhancing the learning skills of academically weak or disabled students. Borkowski (in press) and Brown (in press) both point out that (a) self-questioning techniques force students to become more fully aware of their processing behavior, and (b) such techniques are applicable to a wide variety of learning and problem-solving situations.

Markman (in press) has suggested several activities for developing monitoring skills which provide students with opportunities to read structured material, practice formulating expectations, evaluate inferential and explanation statements, and find problems embedded in texts. Markman argues that the simple stories and descriptive materials typically found in basal readers do not provide young children the opportunities to read and process structured material. Because she believes that good readers use the structure of texts to monitor their comprehension behavior, Markman suggests that students be given practice in such activities as predicting outcomes, inferring the effect of a causal sequence, and inferring a cause when given an effect. She also says that students should practice finding and correcting problems in disorganized or scrambled texts. She claims that such activities give students opportunities to consciously identify causal, temporal, and logical interrelationships in texts, which in turn help to establish a conscious awareness of how texts are typically structured and organized to convey meaning.

Flavell (1979) suggests that students be taught to introspect about their own cognitive or comprehension behaviors. He does not provide specific guidelines for teaching, but suggests that students be involved in activities that bring feelings and ideas to a conscious level and that they be encouraged to attend to those feelings. Flavell (1978a) agrees with others who believe that students should be taught to monitor and "debug" their comprehension behavior. He provides some general suggestions about developing procedures for teaching monitoring strategies and he cautions that students will not use strategies that (a) require too much effort or (b) have no apparent effect in helping them learn and do better in school.

Borkowski (in press) also says that students, especially those classified as having production deficiencies or as being "impulsive learners," should not only be taught strategies but also be shown why a strategy is effective and when, where, and how the trained strategies can be applied in other learning situations. He believes that feedback can be used as a mechanism for nurturing the development of metacognition because feedback increases students' self-understanding regarding the usefulness of a given strategy. As Borkowski puts it, feedback heightens students' metacognitive awareness by "emphasizing the match between task demands, strategic actions, and successful performance" (p. 41 of prepublication copy).

TOWARD SYSTEMATIC GLOSSING

Our experiences so far include (a) developing and trying out prototype glossed materials, (b) working with teachers and teachers-in-training to make informal applications of the glossing technique, and (c) examining selected studies that appear to have particular relevance for our continued efforts. We believe we have reason for optimism. Students report that gloss does indeed help them tackle the complex task of reading expository text. Teachers are not only impressed by the high face validity of the prototype gloss activities, but they are also enthusiastic about using the glossing techniques informally when they teach from content-area texts. And we are satisfied that there is a related literature that offers both general support and specific implications for proceeding with the development of glossing procedures.

We believe that we are now at a point where we have bases for giving serious consideration to the function of glossing as a technique for helping readers understand expository text and for refining our specifications for developing glossed material. In the pages that follow we first discuss an admittedly idealized view of the function of gloss; then we consider the focus of gloss, acknowledging the need for a dual focus on both process and content as well as concern for certain constraints and considerations; and finally we outline some developmental steps for refining the glossing technique.

Function of Gloss

Reading educators' traditional alternatives for improving students' reading comprehension have been to (a) modify the text, (b) augment the text, or (c) modify the students' reading behavior. Each alternative has been the subject of considerable study and each one can be briefly characterized.

Most efforts to improve comprehension by modifying the text have been heavily influenced by the literature on readability. Consequently these efforts have relied on such practices as limiting the average number of words per sentence, substituting easy (i.e., short, frequently occurring) words for hard (i.e., long, technical) words, and modifying sentence structures, usually by making them more like age-peers' oral sentences or by shortening or otherwise simplifying base clauses. The results have not been particularly encouraging, probably because readability--and comprehensibility--depend on a much more complex array of factors than sentence length, word frequency, and sentence structure (Johnson, 1980).

Effective or not, making basic changes in the text can be both costly and unrealistic. Rewriting text is costly in terms of the time required. But even putting that consideration aside, one wonders whether rewriting text accomplishes much in helping students cope with real-life reading tasks. Perhaps a better way is to augment the text through the use of adjunct aids like advance organizers, objectives, and questions. Adjunct aids, as we pointed out in our discussion of mathemagenic behaviors, can be characterized as orienting directions which dispose the reader to respond actively to certain aspects of the text. In general, the most commonly used adjunct aids--advance organizers, objectives, and questions--can be quite effective in helping readers improve their comprehension scores. To oversimplify, then, studies show more positive results for augmented than for modified text. Perhaps this is partly because the adjunct aids do indeed involve the reader as an active participant, whereas modified text does little to change the reader's role. At the same time, there is evidence that the improvement in comprehension scores is caused by items related to the focus of the adjunct aids, not increased global "understanding" of the text. Also on the negative side, the provision of adjunct aids is teacher-directed, so students may never internalize the orienting activities sufficiently to become self-directing. Providing adjunct aids can be like providing crutches without effecting cures.

Attempts to improve comprehension by modifying students' reading behaviors do shift the emphasis from teacher-directed to student-directed activities. The more frequently encouraged activities include imaging, paraphrasing, and traditional study skills like underlining, summarizing, note-taking, and outlining. Studies have demonstrated positive effects for each of the activities; but, in general, the positive effects have been found with older (i.e., high school and college) students who have above-average ability. On the positive side, such activities do indeed involve students in their own learning and offer the potential of being internalized. On the negative--or perhaps more properly, the realistic--side, the activities typically provide very little by way of developing readers' ability to deal with the structure of text. Because many of the activities require the reader to perceive the organizational structure of the text in order to proceed effectively, poor readers--the ones who need help the most--are helped the least.

Reading educators' traditional alternatives share a common flaw: Their focus is too limited. Emphasis is placed either on the text, on the teacher (i.e., teacher-directed activities), or on the reader (i.e., reader-imposed behaviors or strategies); and there is little inclination to pay attention to the interactions among all three. Yet the clear message of the literature, the expressed concerns of teachers, and our own observations and common sense is that attempts to improve readers' comprehension of text must have concurrent regard for the text, the teacher (for the entire instructional milieu), and the reader. To have optimal effect, then, an instructional technique ought to give concurrent consideration to:

1. the background, abilities, and short- and long-term needs of the reader;
2. the expectations of the teacher;
3. the resources of the instructional milieu; and
4. the characteristics (i.e., facts, concepts, structure, organization) of the text.

In other words, the technique would bring together the diverse aspects of a complex teaching-learning process. Our working hypothesis is that we can develop glossing to provide that integrative effect.

A productive instructional technique for helping readers deal effectively with expository text must have two characteristics in addition to the integrative effect. It must secure and sustain learners' active involvement; and it must provide for the internalization and application of the skills and strategies that are taught. Gloss activities can virtually ensure the former if they (a) acknowledge the learners' prior experience, or lack of it, (b) lay out a useful strategy for pursuing the learners' purpose, and (c) require overt, interactive responses from the learner. Whether gloss can effectively do more than set the stage for the latter remains to be seen. That is, gloss activities can straightforwardly call for the application of skills and strategies, thereby setting the stage for internalization; but ultimately internalization and automatized application with "unglossed" material go beyond the activities we can provide. The best we can do is to work out effective strategies not only for initiating but also for "fading" readers' involvement with the gloss activities. We return to this point in the final section of this paper.

Focus of Gloss

When we first began to consider the notion of glossing as an instructional technique, we thought of it mainly as a means for, first, developing and, then, encouraging the application of the specific comprehension skills we had identified in our earlier work. Some examples of specific skills we have worked with are (a) determining the central thought of a paragraph or of several paragraphs, (b) using context clues to figure out the meaning of an unfamiliar word, and (c) identifying relationships to make a conclusion. We still believe that glossing offers an effective way to deal with specific skills; but as we have examined related research and interviewed students, we have been convinced that we need to broaden our focus on skills to include the more general strategies that efficient readers use to understand text.

One example of a general strategy is consciously relating new information, as it is read, to one's prior store of knowledge or to information that was acquired from reading the preceding pages. Such a strategy is suggested in a variety of sources, which include the work related to schema theory, work by Smirnov and Brown in the area of cognitive development, Kintsch's work on developing his model of comprehension, and the line of research related to readers' mathemagenic behaviors. The need for such a strategy is supported by our observation that when students were asked to describe what they do when they read to understand, some of them said that they relate what they read to what they already know or to what they had read previously. Another example of a general strategy is the practice of self-questioning, which is suggested by Smith in his discussion of the implications of schema theory research (see Implications section under Structure of Knowledge) and by several investigators who are interested in metacognition. We also found in our interviews with students that some of them use self-questioning as a rehearsal strategy for remembering as well as for assessing and monitoring their own understanding of what they read.

Through gloss activities we hope, first, to help students become aware of the usefulness of specific skills and general strategies and, second, to help them learn how and when to employ these skills and strategies as they read content-area material.

Although we are mainly concerned with the process of reading content-area texts, we recognize that we cannot focus on process without considering content as well. Consequently, in addition to broadening our process focus to include strategies as well as skills, we acknowledge the need for a dual-focus on content and on process. While we do not claim to be experts in every content field, we can apply the principles of text analysis to materials that were written by experts. Employing such techniques as mapping, outlining, or the more formal text analysis systems described earlier, we can identify important content to be attended to with gloss activities. In other words, properly conceived gloss activities ought to be directed toward enhancing the understanding of specific text content even as they shape the development of "generalizable and internalizable" skills and strategies. The effectiveness of gloss activities that claim a dual focus on content and process, then, must ultimately be demonstrated by a specific (content directed) as well as a more general (process directed) effect: improved understanding of the glossed material and internalized skills and strategies that enhance readers' ability to tackle any reading task.

Up to this point in the discussion we have said that glossing text ought to have an integrative effect--that is, give concurrent consideration to such things as readers' background, teachers' expectations, resources of the instructional milieu, and characteristics of the text--and that gloss must have dual foci which direct attention to matters that are related to process and to content. If the preceding sentence sets parameters for glossing, then our task is to elaborate, clarify, and refine those parameters to a point where we can outline reliable procedures for preparing effective gloss. We expect to pursue that task in the months to come. Figure 1, which depicts interrelationships

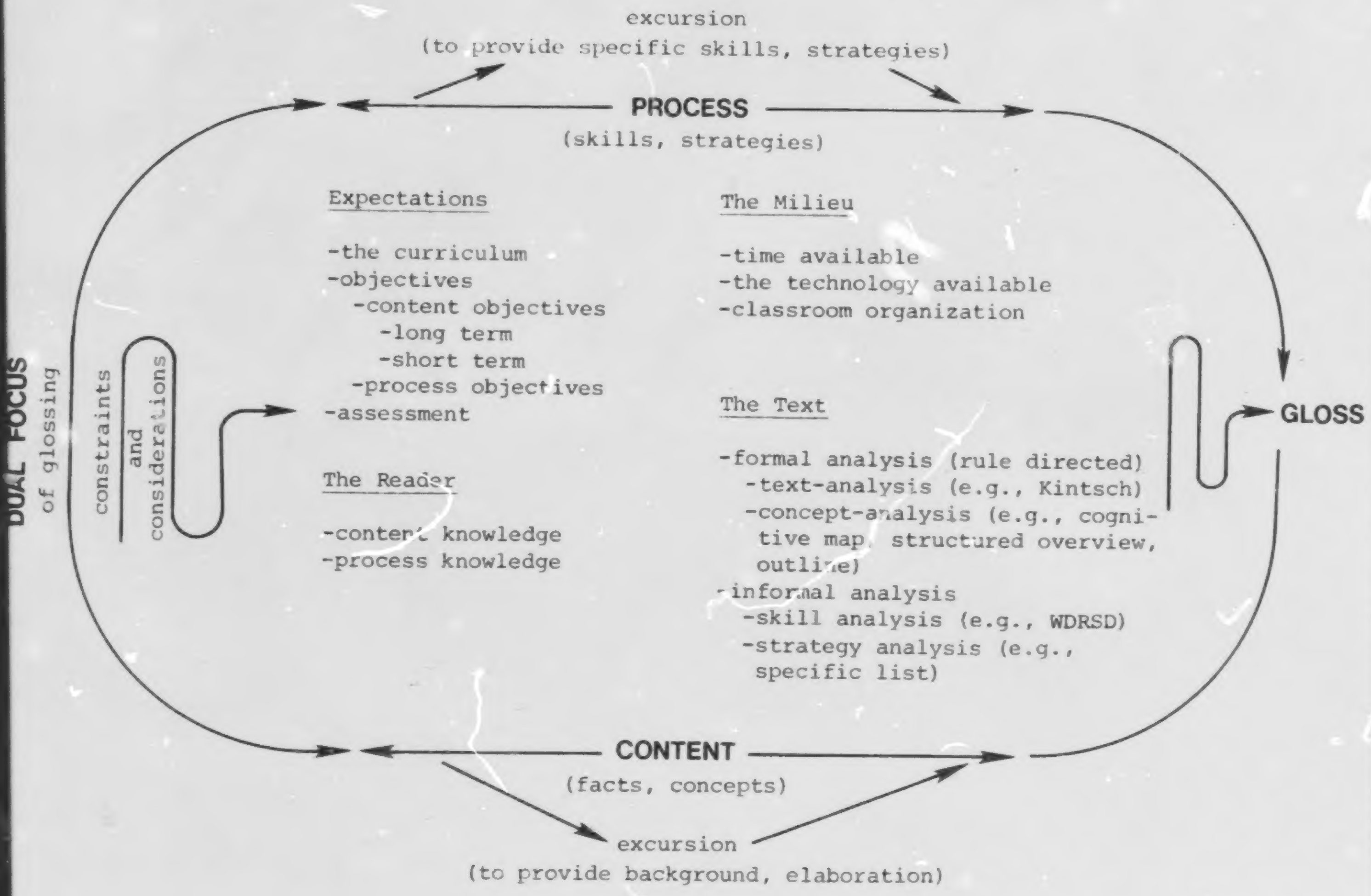

Figure 1. Foci, constraints and considerations for glossing.

as well as parameters, provides some direction. The explanation and discussion of Figure 1 that follows is an attempt to explicate some of the assumptions and concerns that are embodied in the figure.

Parameters and Interrelationships

On the perimeter of the figure, the content and process arrows of the dual foci flow toward the finished product: gloss (text augmented by gloss activities). The arrows are arranged and interrupted to indicate that even as the dual foci direct attention to both process and content, attention is also given to (a) the complex and interacting constraints and consideration of the learning environment, and (b) any possible need for "excursions" either to augment information in the text-at-hand or to enhance the learner's skills and strategies. First we offer some comments on the excursions; then we consider the constraints and considerations.

Excursions

By "excursions" we mean instruction that is offered in addition to the regular gloss activities provided for a specific text. One example, on the process side of the figure, is the kind of instruction offered to a reading skill-development group, where a given skill or strategy is taught intensively and in relative isolation from application in content-area reading. The point of such instruction is to introduce and to sharpen the learners' awareness of the skill or strategy and to provide opportunities for application. While we are attempting to design gloss activities that make for the acquisition as well as the application of specific skills and strategies, the fact is that certain readers and/or certain texts will require intensive preparation for working with the particular skills and strategies stressed in glossed text. (In fact, we suspect that the introduction and sharpening of most skills and strategies is most appropriately handled in such a manner. Whether this is so remains to be seen. The question of when and how acquisition proceeds to application--insofar as the main thrust of instruction is concerned--is an important one.)

An example of excursion on the content side of the figure is instruction that is designed to provide basic background information or to elaborate or augment given information in preparation for reading a given selection of text. Again, the point is that certain readers and/or certain texts will require additional information as a precondition to working with glossed text. Of course the question of when an excursion is called for and when an anticipated lack of background information can be handled with gloss is another important one. It seems almost certain that if gloss gets bogged down with too much basic information it will become cumbersome and sluggish, thereby losing both its appeal and its effect.

For the moment, the excursion lines in Figure 1 acknowledge the likelihood that on certain occasions, yet to be more fully understood, it will be desirable to offer intensive instruction that is related to, but not a part of, the gloss that is prepared for given texts.

Constraints and Considerations

The constraints and consierations identified in Figure 1--Expectations, The Milieu, The Reader, and The Text--are, as we pointed out earlier, aspects of a complex teaching-learning process. It is important that all of these aspects, and the specific factors associated with them, be given consideration in preparing gloss activities. And, if gloss is to have the integrative effect that we are seeking, it is equally important that concurrent consideration be given to, at least, the most potent factors. Yet the reality is that the universe of factors is virtually limitless, so an important part of our task of establishing guidelines for effective glossing is to identify the ones that are likely to have the greatest impact in given situations.

Again, for the moment the aspects of the teaching-learning process that are given in Figure 1 acknowledge the fact that factors associated with each of them deserve consideration and impose constraints on the glossing process. The specific factors and particularly the interactions among them, remain to be more fully understood in terms of their impact. Meanwhile, we have tentatively identified what seem to be some of the more important factors associated with the four aspects identified in Figure 1.

The nature of gloss activities must, of course, be shaped by the explicit and implicit expectations that can be identified. That is, the effectiveness of gloss will be largely determined by the extent to which it is in line with and contributes to the attainment of expected outcomes. Both the goals of the overall curriculum and the stated and unstated objectives of content-area teachers need to be considered to give the gloss direction and focus. The specific measures to be used in assessing outcomes also merit careful consideration, since we know that different measures may yield different results (e.g., Kendall, Mason, & Hunter, 1980).

Consideration of specific factors in *the milieu* makes it possible to deal with the mundane but important matters that often make the difference between failure and success in planning instruction. One obvious factor is the time available; gloss prepared for 1 hour of available time would undoubtedly be quite different in terms of degree of elaboration and types of responses required of learners from gloss prepared for 90 minutes or 2 hours of available time. Likewise, gloss prepared for individuals and gloss prepared for groups *might* need to incorporate different directions and different types of activities in order to sustain interest and effective involvement. And of course gloss ought always to be prepared in view of the best technology available: the most appropriate techniques applied in the appropriate manner for a particular individual or group.

Many factors related to the reader could, and should ultimately, be identified and clarified. But most important for our immediate purposes are the reader's prior knowledge of text content (i.e., content knowledge) and the reader's knowledge of and ability to apply specific skills and strategies (i.e., process knowledge). The preparation of gloss--and decisions about when and how to take planned excursions--will be heavily influenced by both of these factors. Together, they, in effect, are the "givens" to which new information must be related for either assimilation or application.

Similarly, the text is a given that can, presumably, be brought into closer juxtaposition with the reader through glossing. In order for gloss to bring the text and reader closer together, important concepts and ideas must be identified through some type of text analysis; likewise the skills and strategies students need to use in order to read a text must also be determined through systematic analysis. The identification of the important concepts and the skills and strategies needed to read and understand these concepts provides a more definitive focus for preparing gloss activities.

Stages of Gloss

While the immediate focus of gloss is on both content and process, the ultimate goal is to help students not only to acquire, but also to internalize and apply the skills and strategies that enable them to be independent readers of the full range of materials they encounter. Norman et al. (1977) put it like this: ". . . if a child knows how to learn, then he can get the knowledge by himself" (p. 194). If gloss is to contribute to that goal of independence, then we need to do more than simply provide gloss that is effective in improving students' comprehension of text. We must also provide for the systematic internalization and fading of the support that is provided through gloss in order to help students to sustain their use of the skills and strategies when they are on their own. On the basis of our experience and observations so far, we envision four distinct levels or "stages" of preparing and interacting with gloss activities: (a) demonstration, (b) development, (c) internalization, and (d) fading. Each stage can be briefly characterized in terms of focus and function as we see them now.

The purpose of the activities at the demonstration stage is to create awareness of the different features of a text (e.g., chapter heads and subheads) and of the skills and strategies that can be used to read a text with understanding. The main function of the activities at this stage is to provide immature readers with models that approximate mature readers' perceptions relative to extracting meaning from text. That is, the gloss activities, or models, include reflections, queries, and applications that lead students through some of the same thought processes mature readers experience as they read and study expository texts. Demonstration gloss activities describe what is, or ought to be, happening as one reads. We hope that by preparing effective demonstration gloss we can develop students' enthusiasm for working with glossed materials. That is, we want to win them over by showing them that it works and is worth the effort.

Just as demonstration gloss activities provide descriptions of *what* is happening, gloss activities at the *development stage* provide *explanations* that help students to develop an understanding of *how* to make active use of the skills and strategies they need to read and comprehend the content. As we see it now, gloss at this stage should include clarification of behaviors related to specific skills and strategies, explanation of how to use the skills and strategies, and opportunities to apply the skills and strategies in reading content-area texts.

At the *internalization stage* gloss activities should provide opportunities for students to continue to use the skills and strategies that were introduced and sharpened at the development stage in a wide variety of contexts. Again, what we envision at this stage are activities that are designed to help students move closer to independence by helping them move toward metacognition. The activities would go beyond providing opportunities for application and practice; and the focus would be on developing students' awareness of when they need to apply skills to understand text and which skills and strategies are most appropriate in different situations.

By the time students reach the final stage, fading, they will, presumably, have internalized the skills and strategies (i.e., they will have become aware of skills and strategies and be able to apply them in a variety of contexts). The function of the gloss activities, then, is simply to remind readers to think about their own efforts to understand what they are reading, to think about the skills and strategies that will help them to comprehend given information, and to correct any miscues or misconceptions that may be clouding their understanding. That is, to use a term from the work in artificial intelligence, gloss activities at the fading stage should remind students to "debug" their understanding (i.e., eliminate false perceptions) as they read. Students who reach the fading stage will, essentially, have attained the goal we set: They will not only possess the skills and strategies required to read content-area texts, but they will be aware of their ability to use the skills and strategies and know when and how to apply them.

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APPENDIX A

COMPREHENSION OBJECTIVES

COMPREHENSION OBJECTIVES

1. Word Parts -- The student determines the meaning of an unknown word by applying his/her knowledge of prefixes, suffixes and combining forms.*

   *Combining forms are word parts from Greek or Latin. Each combining form has meaning in and of itself and can stand alone in the language of its origin. These word parts usually do not stand alone in the English language but are often combined to form new words. For example, bio (life) combines with logy (study of) to form biology (study of life).

2. Context Clues -- The student uses direct* and indirect** context clues to determine the meaning of an unfamiliar word or the obscure meaning of a familiar word.

   *Direct clues define or restate in a word, phrase, or sentence the meaning of an unknown word (e.g., synonym, definition, equivalent phrase, summary).

   **Indirect clues offer additional meaning or clarification via modifying phrases, examples, comparison/contrast, cause/effect, and main idea/detail clues. No explicit definition of an unknown word is given.

3. Paraphrase -- The student demonstrates his/her grasp of the meaning of sentences by paraphrasing the sentences.

4. Central Thought -- The student generates a central thought of a passage that may or may not have an organizer (topic sentence) and has both relevant and irrelevant information.

5. Relationships/Conclusions -- The student (1) identifies relationships that are either directly* or indirectly** stated in a passage; (2) decides whether or not a conclusion can be made on the basis of those stated relationships in the passage; and (3) makes conclusions based on the relationships given.

*Relationships that are directly stated are given in a single sentence.

**Relationships that are indirectly stated require synthesis of information from more than one sentence.

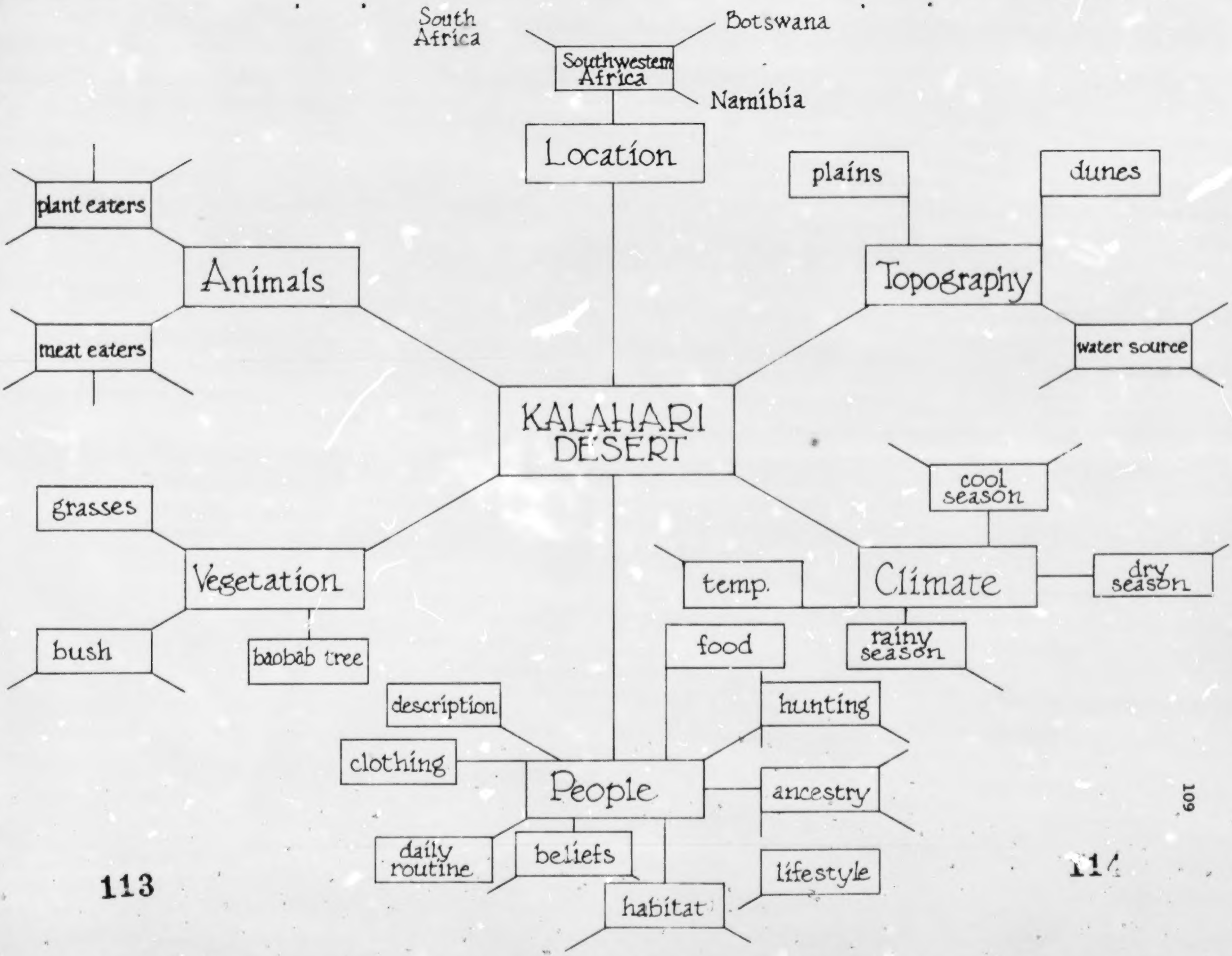
6. Sequence -- The student determines where a specific event occurs within the framework of a series of events by attending to explicit* or implicit** sequential cues.

*Explicit cues are specific words that signal the sequence of events such as next, then, later, soon, finally, while, when, during, meanwhile, as soon as, and until.

**Implicit cues signal a sequence without the use of the explicit cue words; the sequential order is implied in the sentence.

APPENDIX B

EXAMPLE OF A COGNITIVE MAP


South Africa
Botswana
Southwestern Africa
Namibia
Location
plant eaters
Animals
meat eaters
plains
dunes
Topography
water source
KALAHARI DESERT
grasses
Vegetation
bush
baobab tree
cool season
temp.
Climate
dry season
rainy season
food
hunting
description
clothing
People
ancestry
daily routine
beliefs
habitat
lifestyle

APPENDIX C

GUIDELINES FOR PREPARING ACTIVITIES AND SOME EXAMPLES OF SKILL ACTIVITIES

I. Guidelines for Writing Activities

(The major emphasis of all activities should be on encouraging students to become more actively involved in their reading.)

- A. Ask students to:
    1. Paraphrase thoughts in text
    2. Draw inferences from information given in text
    3. Supply concrete examples given in text
    4. Cross out wrong answers rather than always selecting correct answers
    5. Refer to answers from prior activities to solve a new problem
    6. Complete some partially completed activities (either written or graphic)
    7. Explain answers supplied in the activities
    8. Use more than one skill to complete answers
- B. Avoid asking students to:
    1. Do the same kind of activity more than two times in succession
    2. Do large amounts of writing on successive activities

II. Examples of Specific Skills Activities

- A. Context clue activities
    1. A _ _ _* is a way of _ _ _ _ _ _. What in]5 tells the reader this? (Guideline A3)
    2. In the following list of sentences, cross out the sentences that use the word _ _ _ incorrectly according to its meaning in]5. (Guideline A4)
- B. Detail activities
    1. The central thought]8 is _ _ _ _ _ _ _ _ _. What are two important details in]8 that support this central thought? (Guidelines A3, A8)

---

*Dashed lines indicate that specific information from the text is given for the reader.

2. The central thought of]10 is _ _ _ _ _ _*.
   Here is a list of the ideas in]10.
   1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
   2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
   3. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
   4. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

   Put a double check (✓✓) in front of the important ideas that support the central thought. Put a single check (✓) in front of the ideas that are not as important to supporting the central thought. (Guidelines A7, A8)

C. Paraphrase activities

1. Rewrite the central thought of]6 without using these three words _ _ _, _ _ _, and _ _ _. Keep the meaning the same. (Guideline A1)
2. Using the words before, during, and after, rewrite the ideas given in]15 in your own way. Use one or more sentences, but keep the meaning the same. Underline the words before, during, and after. (Guidelines A1, A8)

D. Central thought activities

1. Here is a list of the details that support the central thought in]5. Write the central thought. (Guidelines A2, A8)
2. Read your answers to the central thought questions from]5,]10, and]14 in Section B. Circle the sentence in the following list which is a statement of the central thought of this whole section. (Guidelines A5, A8)

E. Relationships/conclusions activities

1.]7 states a cause and effect relationship between _ _ _ _ _ and _ _ _ _ _. Fill in these blanks:
   ________________________________ is the cause.
   ________________________________ is the effect.
   (Guideline A6)

---

*Dashed lines indicate that specific information from the text is given for the reader.

2. Does]7 contain information explaining why
_ _ _ _ _ _ _ _ _ _* ?
Circle one: YES NO
If you circled YES, what information in]7
explains _ _ _ _ _ _ _ _ _ _ _ _ _ ?
If you circled No, what information is needed
in]7 to explain _ _ _ _ _ _ _ _ _ _ _ _ _ ?
(Guideline A7)

F. Sequence activities

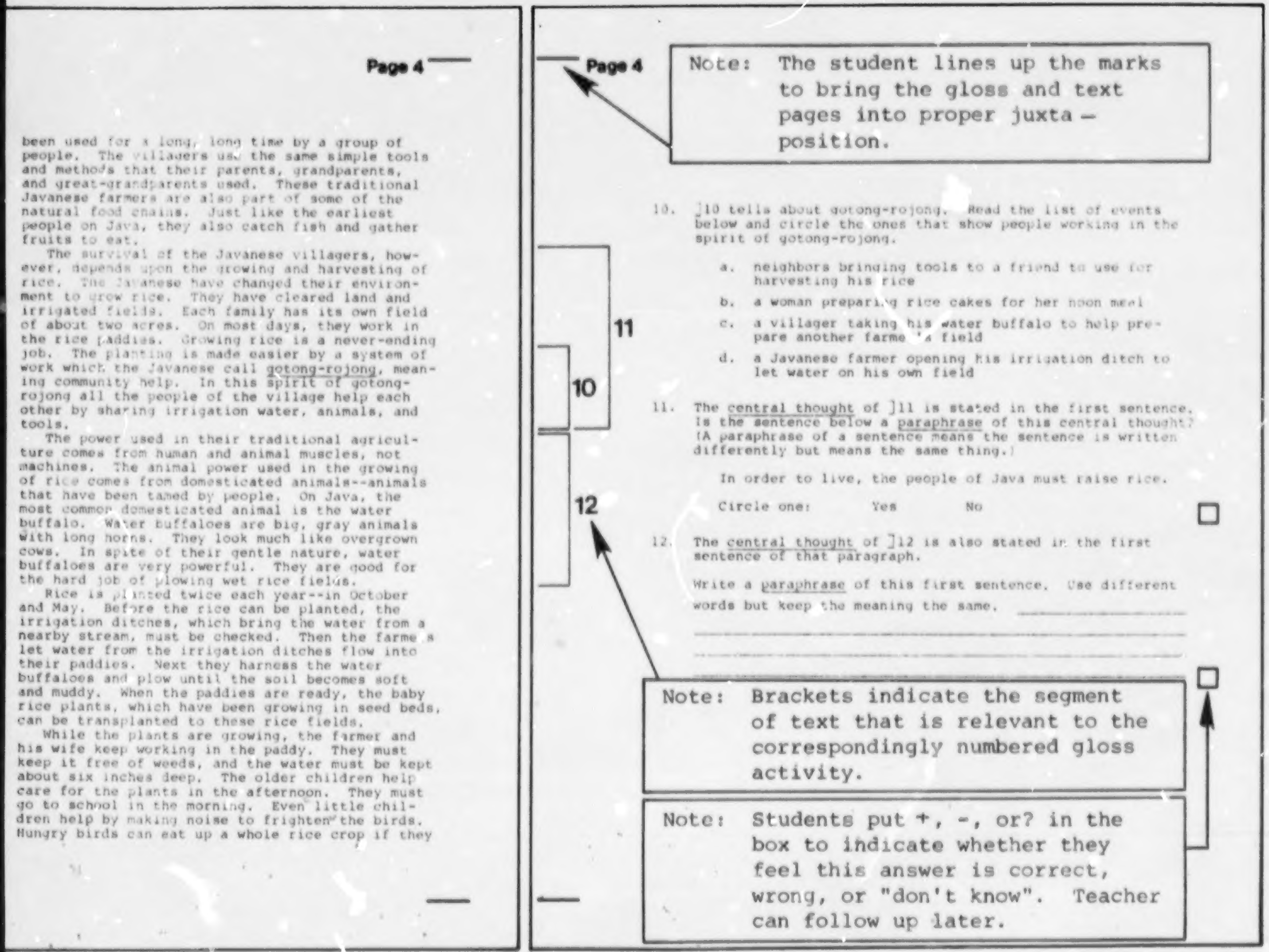
1. Here is a list of some of the steps in the process of _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ . One of the steps given in]5 is missing. Write it here.
(Guideline A6)

2. _ _ _ _ _ _ _ _ happened before _ _ _ _ _ _ _ .
Write the phrase from]5 that tells you this.
(Guideline A7)

*Dashed lines indicate that specific information from the text is given for the reader.

APPENDIX D

AN EXAMPLE OF GLOSSED TEXT


Page 4
Page 4
11
10
12

been used for a long, long time by a group of people. The villagers use the same simple tools and methods that their parents, grandparents, and great-grandparents used. These traditional Javanese farmers are also part of some of the natural food chains. Just like the earliest people on Java, they also catch fish and gather fruits to eat.

The survival of the Javanese villagers, however, depends upon the growing and harvesting of rice. The Javanese have changed their environment to grow rice. They have cleared land and irrigated fields. Each family has its own field of about two acres. On most days, they work in the rice paddies. Growing rice is a never-ending job. The planting is made easier by a system of work which the Javanese call gotong-rojong, meaning community help. In this spirit of gotong-rojong all the people of the village help each other by sharing irrigation water, animals, and tools.

The power used in their traditional agriculture comes from human and animal muscles, not machines. The animal power used in the growing of rice comes from domesticated animals--animals that have been tamed by people. On Java, the most common domesticated animal is the water buffalo. Water buffaloes are big, gray animals with long horns. They look much like overgrown cows. In spite of their gentle nature, water buffaloes are very powerful. They are good for the hard job of plowing wet rice fields.

Rice is planted twice each year--in October and May. Before the rice can be planted, the irrigation ditches, which bring the water from a nearby stream, must be checked. Then the farmers let water from the irrigation ditches flow into their paddies. Next they harness the water buffaloes and plow until the soil becomes soft and muddy. When the paddies are ready, the baby rice plants, which have been growing in seed beds, can be transplanted to these rice fields.

While the plants are growing, the farmer and his wife keep working in the paddy. They must keep it free of weeds, and the water must be kept about six inches deep. The older children help care for the plants in the afternoon. They must go to school in the morning. Even little children help by making noise to frighten the birds. Hungry birds can eat up a whole rice crop if they

Note: The student lines up the marks to bring the gloss and text pages into proper juxta-position.

10.]10 tells about gotong-rojong. Read the list of events below and circle the ones that show people working in the spirit of gotong-rojong.

   a. neighbors bringing tools to a friend to use for harvesting his rice
   b. a woman preparing rice cakes for her noon meal
   c. a villager taking his water buffalo to help prepare another farmer's field
   d. a Javanese farmer opening his irrigation ditch to let water on his own field

11. The central thought of]11 is stated in the first sentence. Is the sentence below a paraphrase of this central thought? (A paraphrase of a sentence means the sentence is written differently but means the same thing.)

   In order to live, the people of Java must raise rice.

   Circle one: Yes No ☐

12. The central thought of]12 is also stated in the first sentence of that paragraph.

   Write a paraphrase of this first sentence. Use different words but keep the meaning the same. ______________________
   ____
   ____
   ____ ☐

Note: Brackets indicate the segment of text that is relevant to the correspondingly numbered gloss activity.

Note: Students put +, -, or? in the box to indicate whether they feel this answer is correct, wrong, or "don't know". Teacher can follow up later.

APPENDIX E

TEST OF MAJOR CONCEPTS

Name ______________________________

Life in Ecosystems

Choose the one BEST answer and circle the letter on the answer sheet.

1. A food chain is best described as

   A. all the plants and animals in an ecosystem.
   B. a series of steps in which energy is passed by eating and being eaten.
   C. the animals in an ecosystem that eat other animals.
   D. the plants in an ecosystem that are eaten by animals.

2. The most important idea in the whole text, Life in Ecosystems, is

   A. every ecosystem has people who farm the land in order to get food.
   B. people, plants, animals, geographical features, and climate interact.
   C. no ecosystem can exist without people.
   D. the climate is more important than the food chains.

3. The difference between the climate of New Orleans and the climate of Java is that

   A. New Orleans is warmer than Java.
   B. New Orleans has more rain than Java.
   C. New Orleans is cooler than Java.
   D. New Orleans is warmer and drier than Java.

4. People rely upon the natural food chains the most in

   A. the Kalahari ecosystem.
   B. the ecosystem of Java.
   C. the ecosystem of the city of New Orleans.
   D. all pond ecosystems.

5. Some plants that did not grow wild in the New Orleans area but were planted by people are

   A. tobacco and rice.
   B. cypress trees.
   C. Spanish moss.
   D. cotton and sugar cane.

6. The Bushmen believe the most worthwhile way to live is to

   A. raise animals.
   B. gather plants.
   C. gather nuts.
   D. hunt animals.

7. The interaction among people, animals, plants, geographical features, and climate forms

   A. an ecosystem.
   B. a food chain.
   C. consumers and producers.
   D. an environment.

8. Earthworms, bread molds, and termites are alike because they

   A. are all producers
   B. are all predators.
   C. are all decomposers.
   D. have chlorophyll.

9. The number and variety of plants and animals have changed the least in

   A. the Kalahari ecosystem.
   B. the ecosystem of Java.
   C. the ecosystem of New Orleans.
   D. all agricultural ecosystems.

10. As the ecosystem of New Orleans changed, the animals that were best able to adapt were

   A. mice, squirrels, and cockroaches.
   B. bobcats, raccoons, and rabbits.
   C. ospreys, herons, and egrets.
   D. turtles, fish, and alligators.

11. The name of a type of tree found in the Kalahari is

   A. werf.
   B. skerm.
   C. mongongo.
   D. baobab.

12. Hunters and gatherers once lived in

    A. only the Kalahari ecosystem.
    B. only the ecosystem of Java.
    C. only the ecosystem of New Orleans.
    D. all three ecosystems.

13. Traditional farmers

    A. use machines to plow and dig irrigation ditches.
    B. use the kinds of tools and methods their grandparents did.
    C. seek new and better ways to farm.
    D. gather nuts and berries in a gotong-rojong spirit.

14. After an antelope is brought home, the Bushmen often

    A. rest for several days.
    B. move to a new territory.
    C. fight over who gets the meat.
    D. have a feast and dance.

15. Examples of plants that grow on the island of Java are

    A. mongongo nuts and tsama melons.
    B. wild pineapples and many flowers.
    C. cactus and baobabs.
    D. cypresses and Spanish moss.

16. People have changed the geographical features the least in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans
    D. all industrial ecosystems.

17. A large river is important to the people of

    A. the Kalahari.
    B. Java.
    C. New Orleans.
    D. all three ecosystems.

18. The mouse-deer, Pelanduk, in the Javanese story is like the people of Java because he

    A. likes to eat plums.
    B. uses his brain in order to survive.
    C. is a hunter and gatherer.
    D. believes in farming.

19. In order to survive, the Bushmen

    A. grow plants that contain water.
    B. plant tsama melons and ga roots.
    C. herd antelope and ostriches.
    D. gather plants and hunt animals.

20. A blend of several different cultures is found in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all three ecosystems.

21. In the Bushmen story about the hunter and the moon, the sun is described as

    A. a friend of life.
    B. an enemy of life.
    C. an animal.
    D. a peacemaker.

22. People have changed the environment the most in

    A. the Kalahari.
    B. Java.
    C. the city of New Orleans.
    D. the plantations around New Orleans.

23. The driest climate is found in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all industrial ecosystems.

24. The biggest problem the city of New Orleans has is

    A. garbage disposal.
    B. making landfills.
    C. sinking land.
    D. air and water pollution.

25. An example of a Javanese tradition is

    A. a story about a mantis and a firebird.
    B. a parade through the village.
    C. a shadow play with puppets.
    D. choosing a king and queen for Mardi Gras.

26. The number and variety of plants and animals have changed the most in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all pond ecosystems.

27. The Bushmen live in bands that

    A. wander only within a certain space or territory.
    B. wander all over the Kalahari Desert.
    C. wander outside the Kalahari during the dry season.
    D. stay in one place and do not wander.

28. The interaction among people, plants, animals, climate, and geographical features takes place in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all three ecosystems.

29. Rice is grown in

    A. levees.
    B. paddies.
    C. copra fields.
    D. irrigation ditches.

30. Long ago cypress-swamp plants and animals lived in

    A. the Kalahari ecosystem.
    B. the ecosystem of New Orleans.
    C. the ecosystem of Java.
    D. all three ecosystems.

31. The Kalahari is in

    A. northern Africa.
    B. eastern Africa.
    C. western Africa.
    D. southern Africa.

32. In an artificial environment, people

    A. change the ecosystem to fit the needs of industry.
    B. adapt themselves to the natural ecosystem.
    C. change the ecosystem to fit the needs of agriculture.
    D. do not change the natural ecosystem.

33. In a food chain a predator is a

    A. producer of chlorophyll.
    B. consumer of plants.
    C. decomposer of dead matter.
    D. consumer of animals.

34. The correct order for members of a food chain in a pond ecosystem is

    A. tadpole, algae, heron, fish.
    B. algae, tadpole, fish, heron.
    C. algae, fish, tadpole, heron.
    D. heron, algae, tadpole, fish.

35. The land is located closest to the equator in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all industrial ecosystems.

36. Creoles are

    A. celebrations with feasts.
    B. a group of people.
    C. leather capes for carrying babies.
    D. tools for harvesting rice.

37. The main crop of the traditional Javanese farmer is

    A. copra.
    B. rice.
    C. tea.
    D. rubber.

38. Some plants and animals have adapted to the environment in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all three ecosystems.

39. The people of the Kalahari

    A. sometimes live alone separate from the rest of the tribe.
    B. live outside the Kalahari in the rainy season.
    C. travel in bands and each band has its own territory.
    D. occasionally war with each other to get new territory.

40. The people of the Kalahari

    A. have beliefs based on their hunting life.
    B. do not have celebrations or feasts.
    C. are not part of the food chains in the Kalahari.
    D. worship the sun, the moon, the mantis, and the firebird.

41. Producers, consumers, and decomposers are found in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all three ecosystems.

42. The people of New Orleans control flooding with

    A. levees.
    B. terraces.
    C. monsoons.
    D. galleries.

43. The wettest climate is found in

    A. the Kalahari ecosystem.
    B. the ecosystem of Java.
    C. the ecosystem of New Orleans.
    D. all industrial ecosystems.

44. The people of Java were able to become farmers because

    A. they had been hunters and gatherers.
    B. the climate and geographical features were suitable.
    C. they could no longer migrate.
    D. they could not become industrialists.

45. The order in which cultures have been developed is

    A. agricultural, industrial, hunting-gathering.
    B. hunting-gathering, agricultural, industrial.
    C. hunting-gathering, industrial, agricultural.
    D. industrial, agricultural, hunting-gathering.

46. All ecosystems have

    A. food chains.
    B. a warm climate.
    C. people who farm.
    D. rivers and hills.

47. The people take only what they need from the environment in

    A. an agricultural culture.
    B. a hunting and gathering culture.
    C. an industrial culture.
    D. an artificial culture.

48. The people change the environment to fit the needs of industry in

    A. a natural environment.
    B. an agricultural ecosystem.
    C. a hunting and gathering ecosystem.
    D. an artificial environment.

49. Birds, plants, and fish are alike because they

A. all kill and eat other animals.
B. are all decomposers.
C. all use energy that comes from the sun.
D. are all producers.

50. People are different from other animals because they

A. are predators.
B. have adapted to their environment.
C. are part of food chains.
D. have developed cultures.

APPENDIX F

TEST OF SKILLS APPLICATION

THE MASAI

Passage I

Life is changing for people in Tanzania, the largest country in eastern Africa. The government has introduced its people to modern farming techniques because the tribes following their traditional ways of living on the land were destroying the vegetation. The customs and beliefs of the people in Tanzania, however, are based upon their traditional ways of life. If the tribes follow the new agricultural practices, a number of these customs and beliefs will be violated. Yet the tribes are being forced to change.

The Masai people live in northern Tanzania. They are an example of a tribe that is facing many changes. The area they live in is a hot, dry strip of grassland marked with occasional patches of thorn trees and open woodlands. Water is scarce and drought is common in this region. Temperatures are consistent throughout the year. They vary by only a few degrees. Rainfall is unpredictable, averaging only about twenty inches in a year. Crops are hard to grow, and the Masai have adjusted to the land by raising cattle.

Passage II

Even though crops do not grow well in this region, cattle can find grass and other vegetation on which to feed. Because there is so little rain, this plant life is important as it protects the soil by holding moisture and preventing erosion. The herds of the Masai often damaged the land by destroying the vegetation where they grazed. Then the soil became dry and new vegetation could not grow. When this happened, the Masai would move to locate new grazing land for their cattle.

In the past the Masai roamed the entire central plateau of East Africa in search of new vegetation and water. In addition to the cattle destroying the vegetation, the Masai themselves added to the erosion problem. As they traveled, they cut down trees to build new huts and to make kraals, or thorn shelters, for their animals. For these reasons, the government of Tanzania has now limited the size of the area in which the Masai are allowed to live.

Passage III

The Masai people are extremely proud of their family origins and traditions and do not want to change their old ways of life. Since their cattle-raising tradition is threatened by lack of grazing lands, the government is encouraging the Masai to grow crops as well as to raise cattle. This violates the beliefs and customs of the Masai who have a strong dislike for stationary occupations.

Masai wealth and social status is measured by the number and condition of the cattle each family has. The Masai are devoted to their cattle. In fact, the word *Masai* means cattle. The cattle are housed and cared for as tenderly as the Masai care for their children. All Masai, the people and the cattle, are believed to have come from Engai, the sky god. The Masai people **believe** that all the cattle in the world were given to them by the sky god and that they are to care for as many of them as possible. In the past, when a Masai family's cattle died of disease or when the family became large enough to be able to care for more cattle, Masai warriors raided other tribes to take whatever cattle they wanted. From this practice, the Masai earned a reputation as fierce and feared warriors.

Passage IV

The Masai value courage, and many of their rituals, or special ceremonies, involve a display of bravery. In one such rite, a Masai warrior must prove his courage by leading a raid on a neighboring village to steal cattle. Killing a lion is considered the ultimate test of male courage. In this ritual, a group of Masai warriors capture a lion without injuring it. The warriors then form a circle around the lion and release it. Before they form the circle, all the women and children assemble to watch. One warrior is chosen to prove his courage by entering the circle, without any weapons, and seizing the lion by the tail. Once this is accomplished, all the warriors fall upon the lion and kill it. The government is trying to change these customs by passing laws forbidding cattle stealing and lion hunting. However, some Masai warriors continue to prove their courage in these traditional ways.

Today, the government of Tanzania has passed laws which are forcing the Masai to alter their way of life. Many of these laws are designed to improve life for the Masai. Programs have been started to encourage the Masai to attend school, follow modern health practices, and use modern agricultural methods. In order for the Masai to obey these new laws and to make use of the new programs, the organization, rituals, and traditions of their society must change.

Questions

Passage 1

1a. Identify or state the central thought of the first paragraph. The central thought is the most important idea the author is trying to explain. All of the other ideas are details that help you identify and understand the central thought.

1b. The government has introduced its people to modern farming techniques is a detail that helps you identify and understand the central thought. Write another example of an important detail in the first paragraph.

2. What does the word consistent mean in line 16?

3. Find the sentence in the first paragraph which has the same meaning as the following sentence:

    The people of Tanzania will not be able to follow their traditions if the government makes them use new methods of farming.

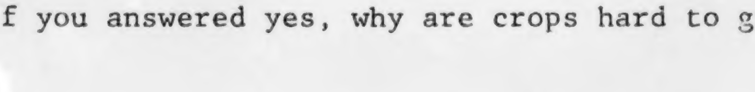
    Copy the first four words of that sentence from the paragraph.

4. Are you given enough information in this passage to know why crops are hard to grow in the land of the Masai?

    (circle yes or no) yes no

    If you answered yes, why are crops hard to grow?

5. Arrange the following events on a timeline in the order in which they occurred. (Place the letter in the appropriate circle.)
    A. Vegetation is destroyed.
    B. Government introduces modern farming techniques.
    C. Tribes follow traditional ways of life.



Questions

Passage II

1. Find the sentence in the first paragraph which has the same meaning as the following sentence:

   The land was often ruined when the Masai cattle
   ate all the grass and other plants.

   Copy the first four words of that sentence from the paragraph.

2. What does the word kraals mean in line 15?

3. Are you given enough information in this passage to know why the government of Tanzania limited the size of the area in which the Masai are allowed to live?

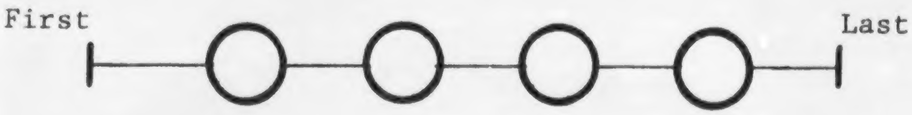
   (circle yes or no)   yes   no

   If you answered yes, why has the government limited the size of the area?

4a. Identify or state in a sentence the central thought of the first paragraph. The central thought is the most important idea the author is trying to explain. All of the other ideas are details that help you identify and understand the central thought.

4b Plant life is important as it protects the soil by holding moisture and preventing erosion is a detail that helps you identify and understand the central thought. Write another example of an important detail in the first paragraph.

5. Arrange the following events on a timeline in the order in which they occurred. (Place the letter in the appropriate circle.)
   A. Now the soil becomes drier.
   B. The cattle destroy the vegetation where they graze.
   C. The Masai must move to a new area.
   D. No vegetation can grow.



Questions

Passage III

1. What does the word Masai mean in line 12?

2a. Identify or state the central thought of the second paragraph. The central thought is the most important idea the author is trying to explain. All of the other ideas are details that help you identify and understand the central thought.

2b. All Masai, the people and the cattle, are believed to have come from Engai, the sky god is a detail that helps you identify and understand the central thought. Write another example of an important detail in the second paragraph.

3. Find the sentence in the first paragraph which has the same meaning as the following sentence:

    The government wants the Masai to raise crops in addition to cattle because there is not enough grassland to just raise cattle.

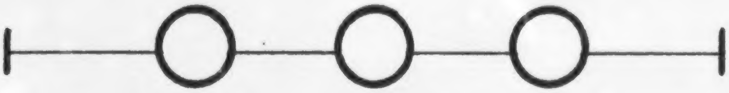
    Copy the first four words of that sentence from the paragraph.

4. Are you given enough information in this passage to know why the Masai believe it is all right to take other people's cattle?

    (circle yes or no)   yes   no

    If you answered yes, why do the Masai believe it is all right to take other people's cattle?

5. Arrange the following events on a timeline in the order in which they occurred. (Place the letter in the appropriate circle.)
    - A. The Masai family's cattle died of disease.
    - B. Masai earned the reputation as fierce and feared warriors.
    - C. Masai warriors raided other tribes.



Questions

Passage IV

1. What does the word rite mean in line 3?

2. Find the sentence in the first paragraph which has the same meaning as the following sentence:

   > Because bravery is so important to the Masai, they have many ceremonies which require courage.

   Copy the first four words of that sentence from the paragraph.

3a. Identify or state the central thought of the second paragraph. The central thought is the most important idea the author is trying to explain. All of the other ideas are details that help you identify and understand the central thought.

3b. Many of these laws are designed to improve life for the Masai is a detail that helps you identify and understand the central thought. Write another example of an important detail in the second paragraph.

4. Are you given enough information in this passage to know what the government will do to the Masai warriors who continue to try to prove their courage in traditional ways?

(Circle yes or no) yes no

If you answered yes, what will the government do to the Masai warriors who continue to try to prove their courage in traditional ways?

5. Arrange the following events on a timeline in the order in which they occurred. (Place the letter in the appropriate circle.)

A. The warriors form a circle around the lion.
B. The warriors capture a lion without injuring it.
C. The warriors release the lion in the circle.
D. The women and children assemble to watch.
E. One warrior seizes the lion by the tail.